RESEARCH NEEDS IN TRAFFIC SAFETY

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HEARING

BEFORE A

SUBCOMMITTEE OF THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE HOUSE OF REPRESENTATIVES

EIGHTY-FIFTH CONGRESS

SECOND SESSION

PANEL DISCUSSION ON NEEDS FOR TRAFFIC SAFETY RESEARCH

APRIL 23, 1958

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RESEARCH NEEDS IN TRAFFIC SAFETY

WEDNESDAY, APRIL 23, 1958

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON TRAFFIC SAFETY, OF THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The subcommittee met at 10 a. m., pursuant to call, in room 213, Old House Office Building, Hon. Kenneth A. Roberts (chairman of the subcommittee) presiding.

Mr. ROBERTS. The subcommittee will please come to order.

First, let me say that I am delighted at the interest this group has shown in the matter of research in traffic safety and by their presence here today. The Chair feels, and I believe all members of the subcommittee feel, that it is imperative that we establish our position in the field of traffic safety research and that we measure the distance we have traveled and the distance we yet have to go.

With this in mind, we have asked a number of leaders in several diversified fields of research to come here today and tell us what progress has been made in their particular fields and what their future plans and objectives are.

The subcommittee is functioning today largely as a listening post so that we may better understand the position of the professionals in the traffic safety field.

The moderator of our panel is Dr. Ross A. McFarland, professor of environmental health and safety, School of Public Health, Harvard University.

Dr. McFarland will introduce each panelist in turn and I will ask the members of the subcommittee to address all questions through the Chair to Dr. McFarland, who will assign the questions to the appropriate panelist.

I want all of you to know that I am expressing the thanks of the subcommittee for your coming. We realize that you are valuable people, that you are busy people, and that you are important people. We know that many of you are here from great distances, that you come at great expense and effort to yourselves, and we feel that you are making a great contribution to this cause in which we are all so interested.

With that, we will proceed with the panel discussion.

STATEMENT OF DR. ROSS A. McFARLAND, SCHOOL OF PUBLIC HEALTH, HARVARD UNIVERSITY, PANEL MODERATOR

Dr. MCFARLAND. Mr. Roberts, we consider it a great honor to come here to discuss this important problem with you. All of the men

around the table have been engaged in research work in this field for many years, in some cases for 25 years.

We know that all of these panelists have given a great deal of thought to the subject and it is obviously difficult for them to express 10, 20, or 25 years' experience in a short statement. I am pleased to say that each person has prepared a statement which will be on file so that your committee can pursue these ideas in greater detail later.

The procedure that we have worked out is to ask each panelist to give a brief statement highlighting the impression of his experience and to try to point up the basic problems for research in this field.

I am pleased to call on Dr. Goddard first. He is Chief of the accident prevention program in the United States Public Health Service. I am calling on him first because he is going to summarize very briefly the results of some of the initial data from the National Health Survey in the field of accidents.

As you know, this is a survey currently being undertaken by the Congress through the Public Health Service, and I am pleased to report that accidents have been included as one of the areas under investigation for the first time. Thus, we hope to have additional, precise information on the nature and the overall problems involved in the general field of accidents as well as highway safety in particular.

Dr. Goddard.

STATEMENT OF DR. JAMES L. GODDARD, UNITED STATES PUBLIC HEALTH SERVICE, WASHINGTON, D. C.

Dr. GODDARD. Mr. Roberts, committee members, I appreciate the opportunity to appear once again before this committee to present some new facts concerning the need for research in highway safety.

I shall not attempt to provide a detailed list of research needs or a comprehensive program to meet these needs. This will be done by the other members of this panel of experts. Instead, I will limit my remarks to the presentation of data on the health problems created by highway accidents.

These data, made available by the national health survey, provide us with new dimensions to the problem and indicate clearly the need for an intensive research program.

In 1956, according to data from the National Office of Vital Statistics, there were 94,350 deaths from accidents of all types. Motor vehicle accident deaths accounted for 43 percent of this total (fig. 1).

An estimate of nonfatal injuries, derived from the first 6 months of the national health survey, indicates that there are 50 million injuries each year in this country from accidents of all types.

These injuries are severe enough to require medical care or to disable the person beyond the day of injury. Ten percent of this total number of injuries can be attributed to motor vehicle accidents. This means, approximately 5 million nonfatal injuries each year (fig. 2).

For the first 6 months of the national health survey, July through December of 1957, there were 2,444,000 injuries from motor vehicle accidents suffered by both sexes. The males had a total of 1.3 million approximately, and the females 1.09 million. The largest accumulation of injuries occurs in the age group 15 to 24, 748,000 occurring in this age group, with the males suffering some 482,000 (table 1).

Table 2 indicates more clearly the differences that exist in age groups because it is done on a basis of a rate per thousand persons per year. This is the estimated annual incidence of nonfatal motor vehicle injuries per thousand persons for the United States, and you will notice that for all ages and both sexes the rate is 29.

Under 15 years it is quite low, but in the age group 15 to 24, for both sexes, the total was 72 per thousand per year. In the male, in this age group there are 100 injuries per thousand per year, whereas the female in this age group suffers only 47.

The next higher age group again illustrates a marked difference in that there is a sharp decrease to a rate for both sexes of 31 per thousand per year, the males having 35 and the females 27.

I think that this shows very clearly why we must be concerned with the youthful driver, and the need for additional study as to the factors which produce such a great discrepancy in the rates between the various age groups and sexes.

It is my hope in presenting these data that the committee will continue its interest in motor vehicle accidents as a health problem, as well as an economic problem; and will provide the impetus for the development of a sound national research program to help solve the problem of highway accidents and injuries.

Thank you.

Mr. ROBERTS. Thank you, Dr. Goddard.

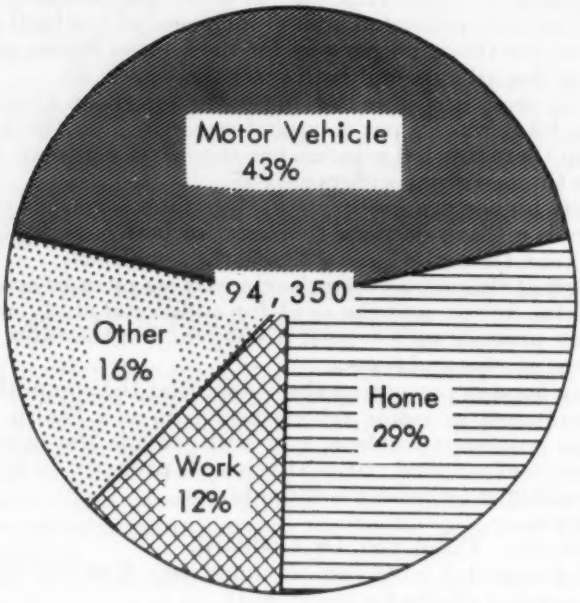
Dr. McFarland, I have just one question. Can the data from the slides be made available for the record?

Dr. GODDARD. Yes, sir.

Mr. ROBERTS. Without objection, they will be incorporated in the record.

(The figures and tables referred to follow:)

DISTRIBUTION OF ACCIDENTAL DEATHS
BY CLASS OF ACCIDENT
UNITED STATES - 1956



Based on estimate by National Office of Vital Statistics

FIGURE 1.

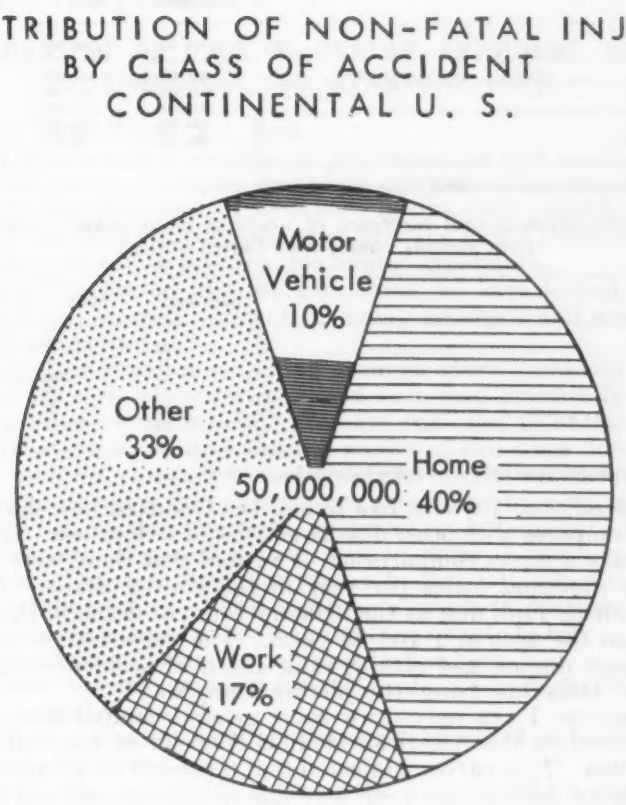

DISTRIBUTION OF NON-FATAL INJURIES
BY CLASS OF ACCIDENT
CONTINENTAL U. S.
Motor Vehicle 10%
Home 40%
Work 17%
Other 33%
50,000,000
Based on preliminary release by National Health Survey

FIGURE 2.

TABLE 1.—*Estimated incidence of nonfatal motor-vehicle injuries during July–December 1957, continental United States*

	Both sexes	Male	Female
All ages	2,444,000	1,346,000	1,097,000
Under 15	281,000	104,000	175,000
15 to 24	748,000	482,000	265,000
25 to 44	710,000	387,000	323,000
45 to 64	491,000	284,000	207,000
65 and over	209,000	85,000	124,000

Source: Preliminary release by United States national health survey.

TABLE 2.—*Estimated annual incidence of nonfatal motor-vehicle injuries per 1,000 persons, continental United States*

	Both sexes	Male	Female
All ages	29	33	25
Under 15	11	8	14
15 to 24	72	100	47
25 to 44	31	35	27
45 to 64	29	34	23
65 and over	29	26	32

Source: Preliminary release by United States national health survey.

Dr. MCFARLAND. I would like to ask Dr. Goddard how data from this area compares with other disease entities in seriousness. Is it possible to make a direct comparison? You said that there were 100 injuries per thousand males per year in the United States. As you know, accidents rank first as the primary cause of death in this country between the ages of 1 and 35 years. The degenerative diseases, such as heart disease and cancer, rank ahead of accidents after this age range. Does this change this picture in any way?

Dr. GODDARD. I can only draw some general comparisons, one of which is based on the American Medical Association hospital survey made in 1955. This survey indicated that 8 percent of all admissions to the hospital during that year were due to injuries suffered in accidents. Total hospital admissions numbered 1,500,000. I do not have the detailed breakdown as to the nature or place of injury, highways versus home. However, a significant proportion of these admissions were due to motor-vehicle accidents.

Another indication of the magnitude of this as a health problem is pointed up by the fact that injuries from accidents are now the leading cause of surgery, with the exception of tonsillectomy in the young male.

Additional comparisons will be made in the coming months from the data of the national health survey. I can state that the morbidity from accidents will probably range extremely high along with some of the more common diseases, such as colds and virus infections.

Dr. MCFARLAND. Thank you very much.

I think that helps to set the problem, and we are all aware of the seriousness of this problem.

Let us go on to some of the panelists in regard to their point of view about the research in this area.

I am first going to call on Dr. Jack W. Dunlap, who is president of Dunlap & Associates. Dr. Dunlap by profession is a mathemati-

cian, statistician, and psychologist. I do not know which figures more prominently in his thinking, but all are obviously important in this field.

Jack, will you proceed?

STATEMENT OF DR. JACK W. DUNLAP, PRESIDENT, DUNLAP & ASSOCIATES, INC., STAMFORD, CONN.

Dr. DUNLAP. Thank you, Ross.

Mr. Chairman and members of the committee and members of the panel and guests, I am not one of the 25-year-old experts that Ross was referring to earlier. I have been in this field, roughly, 10 years. My staff has done considerable work over the past 7 years in the field.

My remarks will be based on this limited experience.

During this period of time, gentlemen, we have looked into auto accidents and aircraft accidents and ship accidents and also, into industrial accidents.

During this time, in searching through these accidents, we have attended all sorts of conferences, and have read practically every bit of public research in the field. We have examined all of the statistical studies that we could find and the results of this come down to this: So far as solid research is concerned, on a relative basis about all that we know today is that accidents are caused by cars, people, and roads. That is a true statement, by definition, but it is not a very helpful statement. We need some details in order to improve upon the situation. The mere fact that we are here today indicates the complexity of the problem. If it had been a simple problem and a simple solution would have solved it, we would not have to be here.

Let us examine the complex of three factors here.

We have the environment for the roads, we have the individuals, and we have the cars.

We want to find out what are the causal effects of each of these, and how they contribute to it.

I would like to indicate some of the areas in which research and knowledge is lacking. There is a great deal of opinion and a host of beliefs, but there are very few facts, gentlemen, when you start to search the data. For example, what is the relationship of an individual's behavior to accidents? Is he concerned with risk-taking behavior?

Why does an individual take a risk?

Why do some refuse to take risks?

Why do they behave the way they do?

We know very little about the vehicle itself and its relationships to accidents.

We hear a great deal of talk about horsepower. They tell you that 300 horsepower will cause you to have more accidents than 200, but how many more, of what severity? We do not know these things.

The same thing is true for the brakes and windshields and other components of a vehicle.

We come to highway design, and we have experts here today, but I cannot find anyone who can tell me what happens if you add 1 foot to the width of a traffic lane or decrease it a foot. What happens with regard to varying the number of lanes, the grades, slopes, curves, and various types of surfaces?

This indicates, rather briefly, some of the areas that we need to look into in terms of the causal factors of accidents.

On prevention, what have we done on prevention? I am afraid I am going to sound sarcastic, but I do feel that way about most preventive action. We have many remedies suggested to us, but very few of these remedies have any proven or demonstrated reliability. We do not know how effective they are. There is no evidence or, at the least, a very minimum amount of evidence as to their effectiveness. I must admit that many of them have a great deal of face validity. Otherwise, we would not have spent the time upon them that we have. Nobody can show me the facts that a given poster or slogan or any number of them have saved a single life. I can find no evidence which is conclusive that driver-training programs have been effective and have saved lives, or that the number of patrolmen that we put on the highway affects this.

With all the exhortations and pleadings and handwringings that occur in the newspapers and over the radio and in various speeches, I do not know whether they have saved a single life. I have beliefs, but that is a long way from facts.

I do not know what, if any, are the elements in those speeches that are effective and which are the elements that are not effective. I do not think anyone else does.

For example, testing, selection, and training. We do not know exactly what these things have contributed; licensing procedures, vehicle inspections, for all of these we lack factual evidence.

We talk a great deal about accident proneness. We do not even know if accident proneness is a valid concept or just something that we have postulated, and we are not able to identify individuals who supposedly are accident prone.

Now, let us look at research. I have mentioned some of the causal factors and the factfinding we must have. There has been very little done in formal solid research in the quantitative sense. We grab rather frantically at any sort of data presented to us, and then rush out and think of something to do, but we have no checks on the success or failure of our actions.

We have here a situation where some 40,000 people are being killed each year on our roads. You would suppose that there would be a great deal of organized, strongly supported research. Yet the best figure that we have been able to obtain is that less than $2 million a year is being spent on this particular problem. We find that even larger sums are being spent by many altruistic foundations on such things as smog abatement and Asian flu, to mention only two.

When you look at the companies who have financial interests in accidents, the insurance companies, the automobile companies, the truckers' associations, and so forth, they are supporting certain studies, but in a very limited way compared to their stakes and to the studies that need to be done.

You can do research, gentlemen, and support it, but it is not going to solve all of the accidents. It will simply reduce accidents, but the reduction of accidents is the heart of our problem at present.

We have in this country the finest experimental situation that you can imagine, and this experimental laboratory, which is a national one, is our own highways, the cars that are upon them, and the various variations of roads. It is a beautiful experimental situation to study.

The only thing that is wrong with it is that it is so complex, there are so many variations of roads, highways, and people in cars, but the data are there and the critical factors with which we are concerned can be teased out. However, to tease them out will require the following things:

First, extreme care in the design of the experiments. Second, the collection of almost inordinate amounts of data in order to sort out those particular components which are of interest and which wil give the facts we need.

The statistical analyses are going to have to be somewhat more complicated than those of simply determining means. These are technical problems, which will require skilled and ingenious mathematicians.

We are not going to solve this problem by having more money to spend on accident research or by having more workers. More money is needed, but the important thing is to find the right kind of people to work on accident studies.

We need to approach this problem from the cold, the hard, the rigorous approach of the scientist rather than from an emotional or sentimental standpoint.

We need to have the scientists bring to bear upon these problems the techniques, tools, and mathematics that they have used to solve other problems equally complex and equally large.

We have gone about this in a so-called practical manner. Let us approach it in an impractical manner.

I submit that, as of today, the so-called practical solutions have not been entirely successful. Otherwise this hearing would not be held. I suggest, therefore, that perhaps the time has come to approach a problem of this complexity from the theoretical, the longhair, or, if you prefer, even the eggheaded viewpoint, to determine what are the basic causes, what are the techniques that are needed, and how can devices be set up for measuring the effectiveness of these techniques.

This will require a team of engineers, physicists, mathematicians, statisticians, psychologists, and last, but not least, medical men and psychiatrists.

These are the things that we have to do to get fundamental studies on causation of accidents as a basis for developing basic types of preventive techniques.

This Government is planning to spend, very shortly, $23 million to determine the effectiveness of various highway surfaces for taxation purposes. It is a shame that they do not spend a like amount upon the reduction of 40,000 fatalities a year.

Thank you, gentlemen.

(Dr. Dunlap's prepared statement is as follows:)

Remarks on Accident Research Needs

By Jack W. Dunlap, President, Dunlap and Associates, Inc., Stamford, Conn.

Accident Research Needs

Our organization has been engaged in accident research for the last 7 years. During the course of our work we have looked into a great many accident situations from turnpike automobile accidents to aircraft and industrial accidents. We have spoken to hundreds of safety officials, highway administrators, municipal, State and Federal officers. We have attended countless conferences, symposiums, and committee meetings. We have read practically every research

document which has ever been published. We have pored over countless statistics and read many accident reports and descriptions. Perhaps this would be an appropriate occasion to review our findings. What do we really know about accident causation? How effective are the techniques which we are applying for the purpose of accident prevention? How much safety are we buying with all our efforts and activities? What must be done if we are to find truly effective remedies for this blight? How far have we gotten and how much further do we have to go?

1. Accident causation

First, I should like to comment on the present status of our knowledge about accident causation. At the moment, the strongest statement which one can make is that highway accidents are caused by cars, people, and highways. It is self evident that accidents are caused by unsafe driving. This is true by definition. But it is a virtually useless kind of information to have. We need to develop a much more subtle and precise kind of information that tells us why and how people behave unsafely. Despite all the advanced psychological theories, we know almost nothing about the kinds of behavior which contribute to accidents or how to influence them.

We know virtually nothing about the contribution of the vehicle to accident causation. For the past few years considerable work has been done to help understand better the pattern of injuries to passengers once an accident has taken place. But, almost nothing has been done to help us understand how such things as horsepower, brakes, windshield area and other design properties contribute to accidents.

The same sort of comment can be made with regard to the effect of environmental factors such as highway design and operation. Different highways and adjacent sections of the same highway have considerably different accident rates. Most of the time we don't know why. There is some evidence which would suggest that limited access highways have lower accidents rates than other kinds of roads. There is, however, very little that can be said about the effect of such design variables as lane width, number of lanes, lighting, grades, curves, surfacing materials, etc.

2. Accident prevention activities

There are a few, if any, accident remedies whose preventive characteristics have been measured with any kind of reliability. In most cases there is no evidence to indicate that they have been effective at all. In some cases there is evidence to indicate that they have not been effective and only in the rarest instances are we in a position to compare the benefits of a particular method of accident reduction with its costs.

We do not know whether safety posters or slogans have ever prevented a single accident. We do not know whether driver training programs really make safe drivers. We do not know what relationship exists (if any) between accidents and number of highway patrolmen. We do not know what relationship exists between accidents and posted speed limits.

We do not know how to identify with any confidence the so-called accident-prone individual or whether the accident-proneness concept has any intrinsic merit for accident prevention. We do not know whether a single accident has ever been prevented by the testing, selection, and screening of people. We do not know whether our driver licensing procedures or our vehicle inspection rules have any effectiveness in preventing accidents or how much more effective they might be made.

We do not know whether all of the public handwringings and exhortations which bombard us in speeches, in the newspapers and on the radio, have ever really touched a single person. There are some who question whether this does not do more harm than good in the sense of diverting energy which might better be applied by professionals. Unfortunately, at the moment even the professionals do not know enough about human-risk behavior to know how to affect it or whether human behavior can indeed be changed more than fleetingly by casual messages or slogans. Even the President of the United States cannot command or inveigle people to change their behavior patterns on the highway.

3. Accident research

What is being done in the way of careful factfinding and research on the accident problem?

The answer to this question is: Practically nothing. We are so desperately in need of facts that we leap upon a collection of badly collected, improperly

analyzed, and incorrectly interpreted accident statistics as the cornerstone of a new safety campaign. Most of the time no one bothers to find out if the campaign was successful in reducing accidents, and if an attempt is made, the results are usually ambiguous for the same reason the original supposition was valueless. Real research, both basic and applied, in the field of accident research is being carried on by a relative handful of people.

One would expect that with the serious national concern over 40,000 highway fatalities annually, there would be a strongly supported and well-organized research effort underway. There are altruistic foundations and agencies who worry about much less vital problems such as Asian flu and smog abatement. There are many organizations, insurance companies, automobile manufacturers, transit companies, trucking firms, roadbuilders, etc., who have strong financial incentives toward accident reduction but their efforts are minor and often irrelevant to the basic problems.

You might suppose that a major problem like accidents would have attracted more research personnel. Perhaps so, but unfortunately, there are very few agencies or companies offering more than token sponsorship of such research. The best estimate I have heard is that less than $2 million a year is being spent on research to find preventive measures for highway accidents. Most of the groups with a major responsibility for accident prevention have abdicated this research responsibility. Each group claims it is the next one's task, not theirs, with the net result that the total volume of wailing-wall, handwriting conferences is increasing in direct proportion to the accident rate, with little increase in research effort.

Accident research can be fruitful. Our Nation's highways provide the greatest natural experiment on equipment and people that we have ever witnessed. It is not easy to tease out the effects we want to study and to remove the extraneous variables, but it can be done. It requires extreme care in designing the study, an inordinately large amount of careful data collection, and the use of very advanced methods of statistical analysis. To study the effect of lane width might require the collection of exact daily traffic volume data, number of overtakings, etc. But, such studies can be made to produce reliable information on the contributing effect of the many causal factors and on the actual effectiveness of remedial measures. This, in my opinion, is the only long-term hope for accident reduction.

The complexity of our national accident problem and the difficulty of attaining a sound solution is attested by the great effort and money that has gone into it in the past, despite which the severity of the problem is steadily increasing. More money and more well-intentioned workers will not necessarily solve the problem. What is required is the cold, hard, rigorous approach of the professional scientist and experimentalist, with all the techniques, tools, and mathematics at their command. The so-called practical approach has failed so let's try the theoretical or long-haired approach. No single discipline can provide all the knowledges required, rather we will need teams of engineers, physicists, economists, statisticians, psychologists, sociologists, and medical men before serious headway can be made. Fundamental studies are required to determine the causal factors as related to men, vehicles, and the environment, and only then are we in a position to soundly study preventive techniques. The Government does not hesitate to spend $23 million to test the relative value of highway surfacing materials yet boggles at the idea of spending a similar amount for the reduction of manslaughter on the highway.

Dr. McFarland. Thank you, Dr. Dunlap.

This is a very realistic start, Mr. Roberts, and I think that these points that Dr. Dunlap has brought out about the necessity of controlled experimentation at a basic research level are very important in the minds of all of us here.

I am next going to call on Dr. Lowell Kelly, professor of psychology, at the University of Michigan. He may be somewhat new to this field of highway safety, but he is not new to the field of accident investigation. I know he has spent many years in areas related to this field.

Dr. Kelly.

STATEMENT OF DR. E. LOWELL KELLY, UNIVERSITY OF MICHIGAN, ANN ARBOR, MICH.

Dr. KELLY. Mr. Chairman, Congressman Roberts, members of the subcommittee, I had the very great pleasure of spending 5 days recently (in February) at a conference in Williamsburg arranged by the President's Committee on Highway Traffic Safety. A panel of distinguished scientists representing a wide variety of specialties and disciplines were briefed by many of the gentlemen around this table and in this room, and then took a fresh look at the overall problem of highway traffic safety and possible solutions to this problem. The complexity of the problem, its magnitude, and its seriousness is such that we felt it could be approached properly only by a varied group of specialists; the panel included mathematicians, psychiatrists, economists, anthropologists, psychologists, engineers, public administrators, biological scientists, political scientists, and others including a theologian.

Although we had a bit of difficulty learning to talk a common language, it very soon became obvious that every one of us and every one of the disciplines which we represented had something to contribute to the problem. Furthermore, because of the nature of the problem, we were convinced that no one discipline and no one approach was likely to do more than make a dent in its solution.

I would remind you that there are many kinds of accidents. Furthermore, it seems likely that most accidents have more than a single cause. Because of the complexity of the problem, and because of the very large number of factors; physical, environmental, sociological, economic, et cetera, which influence driver behavior, it is clear that anything less than a broad scale research approach to this problem is not likely to pay off.

To a large extent the problem with which we are concerned is an American problem because the American scene is so heavily dominated by the automobile. Perhaps this will be true in other nations later but at the moment it is primarily our problem because the automobile is so much a part of our way of life. It is taken for granted that every family is going to have at least one car. It is taken for granted that practically every member of the family 16 years and above will drive that car and, furthermore, it is taken for granted that he has a right to drive it.

Any time that we start talking about restricting privileges of using an automobile, we run into political and social problems of very real magnitude, hence, before we experiment with more rigorous enforcement measures or more restrictive licensing requirements, we must have more firm knowledge on which to base such actions.

We are at the place where we assume that we must have the automobile as a means of transportation and of recreation, relaxation. Some 80 million people in our country drive 700 billion miles a year and except for traffic frustrations we seem to be relatively happy with the situation as it exists.

However, the figures which are familiar to all of you indicate that the automobile, with its combination of speed and weight, is a truly lethal weapon; and when it is not pointed in the right direction, untoward things happen. Even at slow speeds of say 20 miles per hour, an automobile is a potentially deadly weapon.

Our losses from accidents are fantastic—$5 billion is the estimate of the annual financial loss, but this says nothing of the tremendous human cost of 40,000 lives and the much larger number of persons maimed in automobile accidents. I suspect that everyone in this room has probably had the experience of losing a member of his family or a good friend in an automobile accident. Many others are on crutches as a result of someone's poor driving.

What can we do about it?

The one great hope which the group at the Williamsburg conference saw was for increasing our knowledge of those factors of driver behavior conducive to accidents.

As contrasted with relatively extensive and expensive research on roads and vehicles which has already been conducted and which we believe to have paid off handsomely, we as a nation spend relatively little on research on the human factors associated with accident-conducive behavior. The result is that we are lacking in fundamental facts regarding drivers behavior. One of the most dramatic conclusions of the group at Williamsburg was that we do not have a meaningful and hence useful criterion of automobile safety. The most widely used index is the number of fatalities per million miles of driving.

Fortunately, fatal accidents are rare, but because they are rare this common index is very unreliable. It is so insensitive that we cannot be sure whether it is adequate to determine the results of major programs of accident prevention such as those recently instituted in Connecticut and New Jersey.

We greatly need other measures of driver behavior especially such behavior as leads to accidents. Let me give an example:

Sooner or later if a driver goes through enough stop lights or stop signs, he is going to have an accident. Only by developing findings or measures of such accident-conducive behavior can we then evaluate the causes of such behavior and the effectiveness of techniques for modifying the undesirable behavior.

Our group at Williamsburg agreed that the most crucial need at the moment was the development of a series of measures to reflect accident-conducive behavior. With such criterion measures, we could evaluate the usefulness of driver education, different kinds of road signs, different kinds of enforcement policies, or other aspects of accident-prevention programs.

Because of the shortage of time here, I should like the privilege of reading into the record the special report of the Williamsburg conference which I am sure all members of this subcommittee and panel will find of interest. You will note that we emphasize the need for several broad types of research.

Automobile driving in one sense is a very individual kind of behavior. We need to know a great deal more about the individual driver, those aspects of the physical environment to which he responds, those personality characteristics and those inner tensions which cause him to drive less well than he might on the basis of his actual skills. At the same time, we must remember that automobile driving is also a social phenomenon. Driving an automobile on our highways is essentially a social game which must be played according to a set of

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agreed-upon rules. Violation of these rules is poor citizenship whether or not it results in an accident.

Increasingly, therefore, we came to look at the problem of traffic safety as a public health problem which is going to have to be approached jointly by all of those agencies which have been concerned with other public health problems.

We believe that no single research approach, in and of itself, is going to pay off very handsomely. We do not expect simple and dramatic cures or panaceas but we do believe that a research investment on a large scale and with a broad approach to the problem will pay off well. This payoff should be significant with respect both to the financial costs of accidents and also to the less tangible but very real costs in human lives and suffering.

(The documents referred to follow:)

President's Committee for Traffic Safety

Special Report on the Williamsburg Conference

February 23-28, 1958

Sponsored by the

President's Committee for Traffic Safety

(Preprinted from TRAFFIC SAFETY "RESEARCH REVIEW," June, 1958)

DURING the week of February 23-28, 1958 a unique conference of outstanding scientists, representing a number of disciplines, and a staff of professional traffic safety experts met in Williamsburg, Virginia, for the purpose of developing fresh approaches to the problems of traffic safety research. The conference was sponsored by the President's Committee for Traffic Safety, and it was financed under grants from the National Institute of Mental Health, Bureau of Public Roads, Alfred P. Sloan Foundation, and Automotive Safety Foundation.

Attending and participating members are listed below:

Discussion Leader: Dr. David C. Ralph, Head, Rhetoric & Public Address Area, College of Communication Arts, Michigan State U.

Conferees

Dr. Frederick H. Arterton, Washington Cathedral, theologian.

Dr. Carleton B. Chapman, U. of Texas Medical School, biological scientist.

Dr. James C. Charlesworth, Amer. Academy of Political & Social Science, public administrator.

Dr. Donald L. Foley, Dept. of City & Regional Planning, U. of California, city planner.

Dean Harold B. Gotaas, The Technological Institute, Northwestern U., engineer.

Dr. E. Lowell Kelly, Dept. of Psychology, U. of Michigan, psychologist.

Dr. John L. Kennedy, Dept. of Psychology, Princeton U., psychologist.

Dr. Earl L. Koos, School of Social Welfare, Florida State U., sociologist.

Eric Larrabee, Harper Brothers, editor.

Dr. Harold D. Lasswell, Professor of Law & Political Science, Yale Law School, political scientist.

Dr. James L. Malfetti, Safety Education Institut· Teachers College, Columbia U., educator.

Dr. Philip M. Morse, Dept. of Physics, Mass. Institute of Technology, physicist, operations research.

Dr. Benjamin D. Paul, School of Public Health, Harvard U., anthropologist.

Dr. Anatol Rapoport, Mental Health Research Institute, U. of Michigan, mathematical biologist.

Dr. Harold Rashkis, Eastern Pennsylvania Psychiatric Institute, psychiatrist.

Dr. Ralph Roberts, Office of Naval Research, chemist.

Charles M. Tiebout, Dept. of Economics, Northwestern U., economist.

Dr. George Ulett, Dept. of Psychiatry, Washington U. Medical School, psychiatrist.

Dr. Stefan Valavanis, Dept. of Economics, Harvard U., mathematical economist.

Dr. Max A. Woodbury, Professor of Mathematics, New York U., mathematician.

Consultants and Staff

Stanley A. Abercrombie, Assistant Secretary, Nat'l Comm. on Safety Education, education.

Anthony Anthony, Laws Division, Automotive Safety Foundation, legal.

J. Stannard Baker, Director, Research & Development, Traffic Institute, Northwestern U., enforcement.

Dr. Joseph M. Bobbitt, Assistant Director, Nat'l Institute of Mental Health, psychology.

Dr. Theodore W. Forbes, Assistant Director for Research, Highway Traffic Safety Center, Michigan State U., research.

Dr. James L. Goddard, Chief, Accident Prevention Program, U. S. Public Health Service, medicine.

Dr. Herbert H. Jacobs, Vice President, Dunlap & Associates, Inc., mathematics.

William G. Johnson, General Manager, NSC, public education.

Professor J. H. Mathewson, Assistant Director, Institute of Transportation & Traffic Engrg., U. of California, research.

Charles W. Prisk, Director, Highway Safety Study, U. S. Bureau of Public Roads, engineering.

W. F. Sherman, Manager, Engrg. & Technical Dept., Automobile Manufacturers Assn., vehicle design.

J. Wm. Bethea, Exec. Secy., President's Committee for Traffic Safety.

Dr. Leon Brody, Secy., Research Comm., Advisory Council to the President's Committee, Center for Safety Educ., New York U.

Norman Damon, Vice President, Automotive Safety Foundation.

John J. Flaherty, Director, Research Division, NSC.

Dr. Bernard H. Fox, Psychologist, Accident Prevention Program, U. S. Public Health Service.

James F. Kenney, Treasurer, Alfred P. Sloan Foundation, Inc.

Merwyn Kraft, Chairman, Research Committee, Advisory Council to the President's Committee, Research Coordinator, Flight Safety Foundation.

The titles of the opening addresses and the name of the staff members who presented these addresses are listed below:

The Traffic Situation, W. G. Johnson, General Manager, NSC.

Enforcement, J. Stannard Baker, Director of Research & Development, Traffic Institute, Northwestern U.

Engineering, Charles W. Prisk, Director, Highway Safety Study, U. S. Bureau of Public Roads.

Education, Stanley A. Abercrombie, Assistant Secy., Nat'l Commission on Safety Educ., Nat'l Educ. Assn.

Conference Objectives, Dr. Joseph N. Bobbitt, Assistant Director, National Institute of Mental Health.

After the completion of the orientation period, the conferees met in plenary and subgroup sessions for the remainder of the week. The summary report of the conference as presented by the subgroup chairmen is as follows:

Conference Report

Background. The conference was convened "to generate new ideas for traffic-safety research, particularly in the field of human behavior." The need for research on traffic safety springs from the serious and complex nature of the problem and from the inadequacy of existing knowledge. Despite the extensive work already done by individuals and organizations, the current supply of scientific findings is insufficient to provide a firm basis for public policy. The problem of traffic safety, like other important public health problems, demands large-scale support from private and public sources.

Research Strategies. Encouragement should be given to basic as well as applied research. From advances that have occurred in the solution of other problems (in the fields of health and industry, for example) we are convinced that more effort must be devoted to basic or fundamental research.

The phenomenon of highway accidents cannot be fully understood without considering it in the context of routine traffic behavior; hence research must include the study of normal as well as abnormal patterns of behavior.

The nature of the problem makes it necessary that research be conducted both in suitable laboratory situations and in selected field situations (e.g., communities, sociocultural groups and other population segments). In many instances field research can be effective only with the cooperation of civil authorities and informal leaders.

The promotion and support of research should be such that findings of the several appropriate research disciplines may be available for integration and application to the problem at hand.

Research efforts both by groups and by individual workers should be encouraged. For best results, research should be supported on the long-range program basis as well as on a short-term project basis.

To the extent possible, research should be conducted by organizations with a maximum of research talents and a minimum of inappropriate pressures.

* * *

For operating purposes the conferees divided themselves into three groups concerned respectively with the following topics:

1. A systems approach to traffic flow and driver behavior.
2. The psychology of driver behavior.
3. The social context of the automobile, its use and regulation.

It is recognized that the divisions are somewhat arbitrary and not necessarily exclusive. Reports of the three divisions are first presented in summary form; amplification appears in appendices.

I. A Systems Approach to Traffic Flow and Driver Behavior

A vigorous research effort aimed at measuring actual traffic dynamics and actual driver-car behavior in various traffic situations is required in order more clearly to delineate dangerous situations and to indicate ways whereby new road and automobile design and modified traffic rules can increase traffic flow and reduce traffic hazard. This research effort should include at least four coordinated activities:

1. Recording and analysis of the actual flow of traffic in various localities at various times and conditions of stress;
2. Using the parameters of traffic dynamics obtained from (1), simulating traffic flow by digital computing equipment so that special situations can be studied in detail and the effects of experimental modifications can be measured quickly and safely;
3. Equipment of special cars to observe the behavior of the individual driver in relation to his traffic environment as he drives along, to supplement the mass observations of (1);
4. Development of equipment to simulate the traffic environment of the driver, to supplement the observations of (3) and to extend them into situations of stress which might involve danger of accidents. Such a driver-environment simulator might also be of use in determining the efficiency of training or testing programs and in determining the effects of alcohol, fatigue, and other factors on driver behavior, though correlation with the results of (1) and (3) would be required to insure realism of the findings.

The quantitative analysis involved in the program just described presupposes a proper selection of a great number of statistical indices. However, what these are can be decided only as the program develops. Therefore, the program needs to be supplemented by a methodical development of proper statistical techniques. The development of such techniques involves an additional dimension of statistical research; what amounts to a demography or an epidemiology of traffic behavior. This should be carefully coordinated with a continuing, nationwide, standardized, statistical reporting system (corresponding to vital statistics, etc.).

More detailed suggestions as to procedures and minimum specifications for each of these programs is included in Appendix I.

II. The Psychology of Driver Behavior

Driver behavior as a system can be described as being composed of three elements: input, organization and output. These need not be investigated separately, but are so considered here for convenience.

Input is of external and of internal origin, arising in the external environment or from within the organism. The input is integrated and made meaningful by the organization factor, which selects that which will become output from available motor skills.

The input for driver behavior requires intensive investigation. We need to know what constitutes effective input and the variance of its effect on output in the widest possible sampling of drivers.

The organization factor may be considered on two levels. The first is more conceptual or symbolic, requiring higher integrative processes, with a high degree of driver awareness. The second level is more automatic, requiring less awareness.

We need to know how the level of less awareness may be utilized to replace the probably highly variable activity of the level of greater awareness, and under what conditions. How may "big brother" controls substitute even for the more automatic driver behaviors?

It is of special importance that the entire area dealing with attention be investigated, with particular reference to different driving conditions, and in a wide sample of drivers.

Motivational systems account in large measure for the functioning of the organization factor. What are these systems? How do they develop? How may they be utilized in teaching safe driving? How are they influenced by educational measures and by social pressures, especially by the peer group? What is the role of anxiety, and how does it relate to enforcement on the one hand and good driving on the other?

What constitutes effective rewards and punishments in the development of driving skills? How may these be incorporated into an educational program which has as its end point training for effective and safe driving under *all* road conditions?

Output, especially conceived as overt driver behavior, requires objective measurement. For this, instrumentation as well as subjects are necessary. A driver simulator is essential but is not the only device or technique to be used.

Research must not be limited to the driver; the passenger and the pedestrian require the same intensive study.

An elaboration of these descriptions and suggestions can be found in Appendix II.

III. The Social Context of the Automobile Its Use and Regulation

In planning research, the problem of auto accidents can profitably be viewed from various perspectives or frames of reference, including:

a. The *place of the automobile* in American life and in the different subcultures that make up America: the ways in which the use and meaning of the automobile are related to other aspects of our total pattern of life—historical, political, legal, economic, recreational, technological, familial, etc.

b. Highway driving viewed as a *social activity* or dynamic social game involving the role of the driver as affected by his perception of, and interaction with, persons playing other roles on the highway scene (passengers, other drivers, pedestrians, law officers, etc.) and requiring conformity to a socially defined set of rules whose violation constitutes anti-social behavior.

c. Use of the automobile considered as an *economic activity*. So considered, automobile traffic involves choosing between benefits and costs (including indirect and non-monetary benefits and costs) and how they should be allocated and who is to bear their burden. An automobile trip by its very logic tends to differ from an ordinary economic good in several respects—e.g., there are numerous external economies and diseconomies; consumer preferences interact; there is uncertainty, risk, and misperception of risk; there are other kinds of consumer ignorance; there are social overhead costs. The usual market mechanism fails in this area to allocate the burden and to encourage the economizing of human life, time and money. Research should aim at specifying an "ideal solution" and, once this is done, uncover the most profitable next steps public and private policy must take. The problem of the economies of traffic safety is akin to the economies of public health and public goods in general; for instance, schools, courts, defense, etc.

These lines of research are suggested:

a. The development of more valid and reliable measures of traffic safety than are now available, to serve as criteria needed in subsequent research.

b. Analysis of the relationship between serviceable indices and meaningful subdivisions of the entire population (e.g., divisions by social class, age group, educational status, kind of driver training, etc.) so as to generate new hypotheses for explaining highway accidents and for attempting corrective actions.

c. Testing promising hypotheses, techniques and devices—e.g., varying kinds of penalties, different balancing of punishments and rewards, different types and courses of driver education, varying intensities of enforcement, devices for reducing driver anonymity or increasing communication to and between drivers, etc.

d. Systematic examination of the combinations of factors associated with the acceptance and the non-acceptance of effective safety measures by organizations, communities and groups.

e. Study of the possibilities and consequences of modifying the traditional allocation of responsibility for traffic regulation and safety activities among governmental and other agencies.

Appendix I: AMPLIFICATION OF SECTION ON "A SYSTEMS APPROACH TO TRAFFIC FLOW AND DRIVER BEHAVIOR"

*1. **Observation of Mass Traffic Flow***—The position, velocity and acceleration of a car should be measured over about 1000 foot stretches of road, in relation to the relative position, velocity and acceleration of the neighboring cars. A camera or cameras, placed about 100-200 feet above the road, with photos taken about every second, could produce the required accuracy (about 2 feet in position). Long sequences of such shots should be taken at different locations and under different conditions of traffic stress (day, night, dry, wet, presence of police, etc.) The pictures can be projected and the vehicle positions transcribed by "assembly line" methods to punched cards or tape, so that high-speed computers can calculate the changes in velocity and direction of each car as a function of the relative positions, velocities and accelerations of the neighboring cars and of the road conditions. From these computations the probability distributions of car-driver reactions can be tabulated, for analyses in respect to the effects of car and road design—and also as required input for the traffic flow simulation of item 2. On the basis of first observations experiments can be devised to clarify various unclear points.

*2. **Simulation of Mass Traffic Flow***—Using the dynamic parameters of driver-car behavior, a large digital computer can be programmed to simulate traffic flow, to compute positions and velocities of a population of cars on a stretch of road, a sequence of intersections or any other portion of a road network. The variability of car-driver behavior can be included and the density and speed of input can be varied to simulate various conditions of stress. Total flow can be calculated and the nature and number of accidents and near-accidents can be recorded. After the situations observed in (1) are duplicated, to check the realism of the simulation, many simulated experiments can be performed. The frequency of near-accidents and accidents can be measured as traffic stress, of various sorts, is increased, the effect of more strict enforcement of traffic rules could be tested and many other things could be tried out quickly and safely.

*3. **Observation of Driver Behavior***—To complement the measurements of gross behavior of car-driver described in (1) detailed recordings of individual driver reaction to traffic environment should be made. To do this a specially instrumented car or cars must be used which can be driven through various traffic situations, recording what goes on around the car and what corresponding reactions of the driver occur. One possible method of implementing such a program would be an all-round-looking camera which would photograph the car's environment in a circular strip along which absolute direction could be recorded. In the circle within this strip, the film could record time, brake and accelerator position, steering wheel position, car acceleration and any other appropriate phenomenon. Here again photographs could be taken about once a second and the layout should be designed for easy (or perhaps semi-automatic) transcription to digital computer input. Possible results of these measurements could be more detailed knowledge of car-driver reactions to traffic environment, to supplement (1) and required by (2). Other results

would be possible greater insight as to possible changes in car and road design to improve these reaction behaviors. Analysis of these observations will be of help in designing and using the driver-environment simulator of (4).

4. Driver Environment Simulation—A number of complex problems, such as piloting aircraft, have been studied by the development and use of devices that *simulate* dangerous or difficult-to-observe environments. These devices depend on the fact that humans "fill in" much of the detail of the visual field, for example, just how much "realism" is needed to obtain realistic behavior in the stimulation is not known, but the problem can be solved (expensively!) by preliminary experimentation.

The minimum requirement for such a simulation would be an automobile body with seats, instrument panel and controls such that a subject could enter the automobile, start the car, pull away from the parked position into a stream of traffic and drive for "x" hours seeing and hearing stimuli that behave as if they came from the real environment. The simulator must react appropriately to every action initiated by the subject. In particular, he must be able to have "accidents" in the simulator.

It should be emphasized that we are proposing a kind of simulation here that has not been attempted previously because of its complexity and cost. For example, each "vehicle" in the field of view must react appropriately to an action on the part of the driver. It is impossible to program such appropriate reaction into a computer—one must contemplate using a staff of human "stooges" to apply predetermined strategies (which may be quite complex), rather than predetermined responses.

If it were possible to build and finance the operation of such a large-scale simulation device, what would it be used for? It seems to us that such a large driving laboratory might be used first of all to study in a quantitative way what drivers actually do in a variety of normal driving and stressful driving situations. It should help to answer the question as to which of the many aspects of real driver behavior that might be measured is it profitable to try to measure. In addition, the simulator would make possible studies of the effects of drugs, fatigue, motivation, rest pauses, etc. on driver performances.

The problem of cost should be one of the first considerations in contemplating this proposal. Simulation research, particularly where large numbers of people are involved, is an expensive undertaking.

Statistical and Methodological Problems—The available statistics on accidents presuppose several systems of "taxonomy." For example, the 12 types of accidents now used in standard reports presuppose a classification into non-collision and collision and further sub-classification of these largely according to types of obstruction (if any) encountered. On the other hand, some researchers have proposed alternative classifications. For example, one is based on failures to follow a prescribed path and on deviations of the relative direction and velocity of the car (a quantitative vector variable). Still another classification emphasizes type of road, departing from previous conventional classification into rural and urban (which has lost much of its meaning) and arriving at more relevant classification of thoroughfare types.

Many other taxonomies exist, which, it is supposed, are suited to the various purposes for which they have been designed. Clearly, of the first problems in basic research on the general aspects of traffic behavior is to design a taxonomy particularly suited to the types of problems to be considered. This should be done with reference both to types of accidents and to various indices of severity, and any other quantitative measures from which guidance may be obtained toward an understanding of general traffic properties.

There is a serious and relevant problem to be decided in that little is yet known as to whether the individuals who have one or more accidents of a given severity differ essentially from those who do not. To say it in another way, is the accident rate this year higher for the sub-group of persons who had an accident last year than for the sub-group of those who did not? If it is higher, by how much and for what causes?

If the rate of repetition for accidents is higher than the accident rate, but not by much, the problem of identifying the accident-prone driver from his accident record is very nearly as hard as identifying him before he has had an accident. Barring all drivers who have had more than a critical number of accidents will in that case not appreciably reduce the overall rate in the future. In fact it is quite probable that almost all accidents involve normal individuals (i.e., those whose "accident-proneness" [in accidents to be expected per mile] differ at most by a few percent from the average).

The suggestion arising from the analysis underlying this discussion is that sophisticated mathematical and statistical analysis is required to determine the extent of "accident-proneness" in the driver population. The difficulty of determining accident-proneness in the individual is extreme because of the fact that accidents are such rare events.

Summary—The goal of the research program outlined here is envisaged as primarily development of quantitative indices of road behavior which may be considered "normal" within specified conditions. Actual road behavior of different individuals or of an individual over a period of time will exhibit distributions of these indices which, on occasions will pass outside of the "normal range." Whenever this happens in conjunction with a concatenation of certain environmental conditions, a "near-accident" of various degrees of approximation will occur, which in the extreme case will become an accident of a given severity. Since near-accidents occur with a frequency exceeding by several orders of magnitude the frequency of actual accidents, the focusing of research on these situations should alleviate the difficulties associated with the statistical study of rare events.

It seems desirable to have a quantitative study of a continuum ranging from safe to disastrous patterns of behavior in which observational and experimental findings would be given an appropriate theoretical base.

Appendix II: AMPLIFICATION OF SECTION OF "THE PSYCHOLOGY OF DRIVER BEHAVIOR"

Driver behavior can be described as the result of three elements: input, organization, and output, to be defined and discussed below. It should be emphasized that studies of the three cannot be separated arbitrarily, but are being mentioned individually for the sake of convenience.

A. Input—Input is both external and internal.

1. External input refers to sources of stimuli outside of the person in the immediate time environment of the driving situation. Research in this area may be concerned with questions such as the following: What are the perceptual configurations which make up the driver's external input? Particularly, how are inputs which signal actual or potential danger perceived? What are the variations in perception of the same stimulus pattern which can be found among different drivers? Many hypotheses can be generated from knowledge of perceptual variation. For example, we may hypothesize that the number of perceived crises varies directly with the amount perceived and its meaningfulness. Similarly, it is interesting to speculate how the number of actual crises is related to the number of perceived crises. We can even hypothesize, more broadly, that there exists an optimal perception level. In any event, the overall question is to establish the relationships between perception and the criteria of good driving. This implies, among things, the introduction of different ways of observing—either experimentally or by selection from a population. In sum, we need research into techniques of measurement nd description of external input. This should include rrelations with physiological measures (EEG, polygraph, etc.), gross behavioral measure, measures of objective relations among input elements, etc.

2. Internal input—Internal input refers to all information arising from the person. This includes that which comes from the body as well as present psychic states which may have arisen from past experience. We need research into techniques of description and measurement of internal driver input; for example, set, perceptual tendencies, present habits of perceiving, visceral sensations, drowsiness, etc.

B. Organization Factor—The organization factor is the integrator of these inputs. It may be regarded here as including habit systems.

1. Levels of the organizing process and their modification—There are two levels of organizing processes. The first is on the conceptual or symbolic level, requiring attention, highly integrating, and requiring *much* awareness. There is generally a progress during the learning of driving, from the first to the second, i.e., from more to less awareness, for any set of acts. Furthermore, the degree of automaticity finally achieved for various sets of acts varies a driver from set to set and varies from driver to driver. We would like to define various conditions leading to different degrees of automaticity. This definition should come from research. Therefore, research into judgment or decision making behavior is very important. It can guide research on automatic controls which will substitute adequately for the driver's failure.

For example, it might be possible to develop more "big brother" controls than we now have in order to make certain processes of the complex type less complex where they are dangerous, and process of the more automatic type less dangerous.

A "big brother" control might be one such as the automatic signal telling of speed beyond a present level, or a gong, on an express highway where it is dangerous to stop, telling of impending gasoline shortage, or radar control warning of a vehicle too close in front.

We would like to carry out studies on the distribution and loss of attention under various driving conditions. Because it is well known that attention cannot be continuous for a demanding task, it may be that certain types of people, certain types of traffic conditions, certain conditions of the individual, certain habits of behavior, lead to different degrees and numbers of attention lapses. We would like research evidence on these matters.

The task of formal driver education is to teach the predriver how to operate efficiently at both levels of complexity of organizing process. The driver training teacher is concerned with initial learning functions, and not with review learning functions of experienced drivers. There is some evidence that training of fleet drivers may improve their accident experience. Can this question be answered more definitely? Can the ordinary driver's accident experience be improved by review training? How long will such training be effective?

What would be the effectiveness of advanced driving schools where a man could get a certificate or badge or special license plate? This might be an incentive to reach and an incentive to keep. Since most people think they are good drivers, this may be a means of showing them that there are different levels of driving excellence and that what they considered good driving might in fact be dangerous driving indeed. Certainly the effectiveness of the existing British organization of this type should be measured.

The general problem of driver education is receiving some attention, but should probably be examined with much greater care, in an attempt to find out something of the effect of all the various elements of training programs. This means, that evaluation research is of great importance not only as to individual curriculum components, but also as to their distribution in the training courses. Special attention should be paid to training in emergency measures and to attitudes toward the goals of driving.

2. Motivation and its modification—The motivation systems in driving seem to be multiple. We would like to know what these systems are. We would like to select reinforcements for driving so that rewards for the acts in driving are more compatible with certain motivational systems than with others. For example, how is the efficiency of automatic behavior—or for that matter, behavior of any degrees of complexity—affected by changes in anxiety? By others? By one's family? For example, after two moving traffic violations, what kind of behavior characterized the driver if he is threatened by imminent loss of license? This can be related on a theoretical level to the effects of

differences of punishment gradient. What is the relative effectiveness of differences of suspension of license as contrasted with fines?

In practice, good driving habits may be rewarded or actually punished; likewise, bad driving habits may be punished or actually rewarded. We need to study the kinds of reinforcements that exist. We need to study the effects of changing these. For example, an experimental estimate can be made of how satisfying certain behaviors are. How will satisfactions fare when placed in competition with certain punishing factors? Here we can profitably investigate the motivational value of certain risks vs. certain punishments. This is an especially fertile field for investigation because some evidence suggests that while knowledge of increased risk does not effect behavior, other knowledge does. We want to know how much information drivers have about driving risks, and what would happen if they had more information.

All of the above—indeed all motivational studies—must be carried out against the background of early learning and reinforcement of various attitudes toward society, morality, one's peers, etc.

How do all these attitudes develop?

In this connection, it would be very appropriate to study the development of ethical understanding and behavior, feelings of responsibility toward society, toward the family, and in a grimly logical way, toward the entity such as a peer group whose ethics demand that the outgroup regards as unethical? How ethical is it to reward someone for doing what he should do anyhow? How can feelings of responsibility in other spheres be channeled to act just as strongly in the person's relations with other drivers?

In all of these areas of investigation, it will be necessary to select certain subjects as samples of the population as a whole. The sample must include members of various sociocultural groups and subgroups, males and females, different age groups, etc., as well as drivers of different abilities and experience. It is important that drivers who have participated in accidents of specified degrees of severity be available to aid us in finding out what actually happened in these accidents.

It has been asked what might happen to the aggressiveness or other anti-social impulses assumed to be involved in some accident-producing behavior if this outlet were no longer available. Might this not be like a conversion symptom, such as hysterical paralysis of the leg? If modified by some peripheral means, this might be the case; however, if modification were made in basic attitudes, might not the corrective effect be more complete and permanent? This must be investigated; if morality is not instilled in early life, if the bases for responsible behavior are not early established, may it not be too late by the time driver age is reached?

Perhaps a searching investigation must be made of the values of American civilization and of our attitudes toward the automobile as a public institution, perhaps even longitudinal study of this concept. If it is important enough as an influence, it may be time to examine the whole structure of the value systems of the country. The next generation is the one which our educations will influence.

It was brought out previously that there exist motivational systems at various levels and of different kinds. It would be well to relate the different kinds of motivational systems in our drivers. These problems can be attacked experimentally, either in live car situations or in a simulator.

Parenthetically, the amount of profitable research which can be done in a simulator is so great that it would not be amiss to recommend expansion of the program of producing a simulator once the prototype has been developed successfully.

One interesting attitudinal question relates to the popular concept that accidents are inevitable. Means should be examined to discover the possible existence of such attitudes and of means of changing them if they exist.

C. Output—Output includes all the behavior of the individual as a result of initial input, feedback from other behavior, and intermediate organization. We cannot divorce the relationship of output and organization, since different outputs will result from alternative decision-making processes of organization.

We would first like to describe the most efficient motor behavior of the human in general terms, to which questions of automobile behavior can be referred for comparison. For example, the push-pull steering of the Cornell-Liberty car is more compatible with movement actuated by muscles capable of fine control than is the conventional steering wheel, all other things being equal.

Motor behavior can be measured by instruments now available, and some attempts have been made. But the full potential of the methods available to us has not been exercised, principally because of lack of funds. Research in terms of motor analysis is of importance.

D. Research on persons other than the driver—In the areas of attitude, enforcement, motivation, perception, and training, the pedestrian is as fit, and perhaps a fitter, subject for study than the driver.

Personal Comments by Members of Group 3

As a basis for preparing the section on "The Social Context of the Automobile, Its Use and Regulation" which appears as Section III of the "Conference Report," each member of this group agreed to prepare a brief statement. This was to capture some ideas which the group recognized were sufficiently heterogeneous to make it difficult to incorporate them faithfully into any single document. It should be emphasized that, as personal comments, these do not necessarily carry the weight of combined group reports. Written under pressure of time, they reflect rough ideas, not final proposals.

The individual comments follow.

* * *

D. L. Foley:

1. *The social roles of the motor vehicle driver.* Research to focus on the behavior and/or attitudes of the driver as these are influenced by or related to the social roles in which the driver is placed. By "social role" we

meant the position of the driver and the corresponding behavioral expectations associated with that position as this position relates to the positions held by other actors—including other drivers (and their vehicles), passengers, pedestrians, traffic enforcement officers, etc. Mainly this research would seek to identify the multiple roles of the driver, the degree to which these roles are compatible or in conflict, and the ways in which the driver's role situation relates to his driving behavior. Initially, it might be best to seek an essentially qualitative classification of roles and of driving behavior. Methods of research: observation, interviewing, use of situational questions, etc.

2. *The sociology of the automobile.* Research on the place of the automobile in American life, on the institutional patterns and social controls that have grown up around it, and on the ways in which the ownership of and the dependence upon the automobile have become interrelated with other features of our pattern of life.

3. *The societal framework of automotive safety activity.* Research that will seek (a) better to understand the relative place of units of the automobile industry, various levels and agencies of government, and civic, nonprofit or other agencies by which auto and traffic safety features and/or programs are researched, recommended, put into effect, and, as necessary, enforced; and (b) analytically to explore the relative advantages and disadvantages of different "mixes" of governmental, industrial, and other agency activity in this field.

Dr. Charlesworth:

The recommendations which follow are based on the assumption that our hosts are interested in the adduction of new items of knowledge relating to traffic accidents and also in the public implementation of proved proposals. These recommendations are cast in the form of actions to be taken by the President's Committee for Traffic Safety.

1. Invite each state legislative to send two delegates to a national conference, to last one month, to formulate recommendations to the several legislators dealing with enforcement and educational measures dealing with all aspects of traffic safety.

   Some areas of study might be these:

   a. Increase the effectiveness of the examination of drivers, both in scope and depth.
   b. Train local as well as state policemen in the handling of modern traffic on highways.
   c. Distinguish between accidents attributable to wrong attitudes (discomfort, aggressiveness, etc.) and those caused by lapses, and allocate punishments accordingly.
   d. Re-examine drivers every five years.
   e. Make public liability insurance compulsory, and fix rates beyond actuarial needs for repeating offenders.
   f. Exclude strictly private passenger cars from the busiest sections of large cities.
   g. Encourage informing by designated civilians.
   h. Give free driving licenses and a special form of card to drivers with good records.
   i. Cite good drivers in papers and over the radio.
   j. Limit the speed potential and horsepower of passenger cars.
   k. Increase the use of suspensions of license.
   l. Prohibit street parking in congested areas.

2. Persuade congress to make available, from public roads funds, adequate sums to engage in research on matters related to highway and street accidents.

   Some areas of study might be these:

   a. Make saturation studies of particular communities, and compare these with comparable communities not studied.
   b. Determine if there is a positive correlation between bad driver attitudes and American discourtesy in general. (In this, cultures and sub-cultures should be segregated, and communities and the state of conditions in certain foreign countries observed.)
   c. Ascertain the psychological etiology of accidents by intense and prolonged examination of participants in selected accidents.
   d. Ascertain the pattern of position and motion of cars in accident situations.
   e. Identify the principal errors in highway design which lead to accidents.
   f. Correlate the accident record of persons who have received high school training and the kind of training received.
   g. Learn what might be done to make passenger cars safer, by measuring manufacturers' attitudes, public acceptance, and the limits of sternness on the part of public officials.
   h. Ascertain whether deterrents to speed, like well-placed thank-you ma'ams, can safely be built into highways.
   i. Reconcile apparently inexplicably deficient accident statistics with the actual facts in the several jurisdictions.

Dr. Kelly:

1. The magnitude and gravity of the highway safety problem are such that as intelligent people we must undertake a bold and large scale corrective program. However, because of the lack of firm knowledge regarding the relative effectiveness (if any) of alternative proposals for corrective action, it is essential that the program be essentially experimental with ongoing evaluations of all modifications introduced. This required (a) substantial financial support for broad scale research programs, some of which are devoted to basic research and others to more practical matters; (b) willingness on the part of some communities and legislative groups to participate in field tests of experimental programs necessary to establish the basic knowledge required for wise longer term solutions to the problems of highway traffic safety. It appears that a clearing-house-function would contribute to the efficiency with which research monies and energies would be utilized.

2. The fatal accident is fortunately a relatively rare event,

but because of its low incidence as well as because it typically results from the confluence of several "causes," it is of dubious value as a criterion of traffic safety. Since a reliable and valid index of traffic safety is a *sine qua non* for all research leading to the evaluation of any programs designed to promote safety, it is recommended that a systematic program of research be undertaken to develop alternative criterion measures and ascertain the relationships among them. This recommendation has extremely high priority.

3. Driving an automobile on public streets and highways is a form of social behavior, a game of which must be played according to a set of socially accepted rules, if the game is to yield the maximum payoff for all participants. Since approximately nine out of every ten accidents involve a violation of one or more of these rules or laws, it may be concluded that the major precipitating cause of automobile accidents is a set of accident conclusive acts associated with violations of traffic laws. The unsafe driver is a bad citizen. His antisocial behaviors may result from a driver's ignorance of the law, a lapse of attention, or a conscious intent to break the law, but regardless of the cause of such violations, all such behavior is equally inimical to high-way safety and hence, anti-social. A frank recognition of the principle has direct implications for child training, driver education, and for law enforcement practices. Just as a gentleman behaves politely whether the situation demands it or not, the good citizen obeys traffic laws even though there is no other car in sight.

4. Since it is believed that driver behavior would be influenced in a favorable direction by making possible easy communication with fellow drivers in the immediate vicinity, it is recommended that a program of research be undertaken to evaluate the results of installing a simple two-way limited range inter-com system on all cars in a selected community.

5. Since much crude and unsafe driver behavior appears to result from the fact of anonymity an effort should be made to evaluate, in a selected community, the effect of publicity identifying the owner of all vehicles.

Dr. Koos:

1. Driver education (by whatever medium) has, or shortly will become, an essential in American life, and applicable to all who must drive. The auto is not necessarily the most useful instrument of transportation, and it is used because of its status value and its use to the individual as an instrument of power, etc. This value and meaning varies from one subculture or group to another, yet uniform educational techniques (quite meaningless in some instances and to some groups) are applied. Research is urgently needed to (a) determine the group (subculture) variations in the meaning of the automobile to the individual; (b) to determine these group concepts of authority and authority relationships as they relate to the use of safety measures.

2. The relative alarm and resultant action re morbidity and mortality varies from cause to cause (e.g., cancer high), with auto-engendered morbidity and mortality low—despite far greater exposure. It is impossible to sensitize population to safety measures unless we know why and among whom.

Mr. Larrabee:

1. Why is the car a non-social device?

   Hypotheses: It has been institutionalized historical to embody extraneous motivations (power, prestige, etc.) and to serve as a means of expressing them.

   Possible Research: A study of what automobiles mean to their owners, through detailed, but fairly open-minded interviewing.

   Objective: Diversion of such motivations away from the automobiles in future safety propaganda.

2. Why is much safety propaganda ineffective?

   Hypothesis: It is regarded as a limitation on the more powerful motivations embodied in the car.

   Possible Research: Study of same group as in (1) above through questions having a concealed relationship to safety and in re-interview, an overt relationship.

   Objective: Concoction of future safety propaganda in such a way as to evade or counteract conflicting motivations.

3. Why is the automobile an institution refractory to social restraints?

   Hypothesis: The automobile sub-culture has acquired such momentum as to escape from previous controls and has introduced strain and disequilibrium to a degree that seriously threatens our society.

   Possible Research: A study of those organizations which seek the good of the auto sub-culture to the exclusion of the general good.

   Objective: The substitution of a more rational method of arriving at decisions of optimum traffic, use of other forms of transportation, etc.

Dr. Lasswell:

Continuing Survey: Local Communities

1. A continuing research survey is needed to evaluate the relative effectiveness (and cost) of the measures of social action available to organizations whose objective is to reduce accident rates.

2. The research should be conducted under university or research institute auspices in order to get the full benefit of the disciplines concerned with the subject and to focus an approach free from the pressures that often characterize action organizations.

3. Local communities of various sizes (and composition) are one target of such research. Experimental and control communities can be paired; and experimental inputs can be varied from year to year.

4. As results are developed, they can be made available to action organizations.

Continuing Survey: Regions

1. Besides a continuing research survey of community targets, regional areas need to be studied from the same

point of view. In this setting the program will be less perfectly experimental than in the case of local communities, chiefly because of cost factors. However, by agreement with organizations, strategies can be agreed upon in advance and studied as they are applied. In some instances, it will be most expedient to focus upon a limited list of inputs in order to keep within manageable terms.

Continuing Survey: National

1. In addition to a continuing research survey of community and regional targets, the national area needs to be studied from the same viewpoint. At this level it will be even less experimental than at a regional level. By advance understanding with organizations it will be possible to follow strategies as they are applied. No doubt it will be expedient to focus upon special targets within the national field during a given period.

Encourage Independent Historical and Analytic Work

The problems of traffic can be put into the context of American social history and institutional growth by encouraging private scholarly investigations. There are reasons for believing that neither the scholarly community nor the public at large have taken these matters with the seriousness that is requisite to their understanding. Funds should be made available for independent scholarly work, as well as for team research.

The Encouragement and Discouragement of Risk Taking in U. S. Society

Traditionally American public policies, formal and informal have taken a double attitude toward risk. Our individualistic society has encouraged many forms of risk taking. Bold driving is no doubt an example. Our unwillingness to take safety too seriously probably calls for an examination of the whole context of risk. (Firearms, gambling, speculation, etc.)

The Significance of the Automobile in American Society

Legal, economic, political, familial, educational, scientific-technological, religious, rural, medical, standpoints.

Influence of Situational Norms Upon Driving Patterns

(Transmission in all groups of hazardous or responsible pattern.) (Adjustment on movement from one context to another.)

B. D. Paul:

Kind of Study: Studying factors variously associated with the acceptance and non-acceptance of safety measures on the part of groups and populations.

This is but one of many kinds of behavioral research. It assumes that certain effective measures for increasing traffic safety are known, but that these are not generally applied. The research challenge is to identify the combinations and sequences of circumstances that promote or hinder acceptance.

Method of Study: The approach would be essentially qualitative and descriptive and would work from specific cases to generalizations. At the outset there would be more dependence on the ingenuity of the investigation than on the tightness of the conceptual frame, although the aim is to arrive at a serviceable theory of social process. Three variations of approach suggest themselves:

a. Retrospective. Comparison of successful and unsuccessful instances. Example: what combinations of factors led auto industry to make safety locks standard equipment but not make safety belts standard equipment? What seem to be the critical differences?

b. Observation. Select several current and unresolved issues relating to adoption of safety measures; as a bystander, make continuous observation of the process by which the issue is decided in order to capture the decision-making process on the hoof.

c. "Experimental." Try to introduce a safety measure or measures in various communities or situations in order to observe the correlation of differential outcomes.

If all are tried they might best be initiated in the order given.

Object of Study: For any of the foregoing case study methods (recovering history, watching history, making history) the comparison groups or objects of study might be:

a. Political entities ("communities", e.g., towns, or states).

b. Formal organizations, e.g., auto industry or an enforcement department.

c. Social categories, e.g., a socio-economic class or an age group.

S. Valavanis:

I. Research proposals

1. Catalogue the costs of the automobile, especially indirect and non-monetary costs. Estimate the added costs occasioned by more cars, younger drivers, older cars, higher speeds, etc.

2. Tabulate the probability of accident by factor.

3. Study the rationale of differential insurance rates, both theoretically and as insurance commissioners argue about them in fact.

4. What's holding up the technologically most obvious accident-reducing and damage reducing reforms? Historical case studies.

5. Investigate padding of court awards, body and fender repairs, hospital bills, prompted by the pressure of insurance.

II. Action proposals

1. Train drivers not only for ideal but for emergency conditions.

2. Raise insurance rates and teach public they are largely traffic taxes for discouraging a public menace and not merely to raise revenue or to meet claims.

3. Periodic retraining of drivers at license renewal time.

Statement Regarding the Need for Funds for Research in the Field of Traffic Safety

By E. Lowell Kelly, Professor of Psychology, University of Michigan

The automobile has become an integral part of the American way of life; we take it for granted that almost every family will have at least one car and that it will be driven by the father, the mother, and all of the children over 16. The automobile is used not only for essential transportation but also for recreation, relaxation, and sometimes for exhilaration. Thanks to our excellent system of roads and to the advanced state of mechanical development, some 80 million persons drive nearly 700 billion miles per year. To be sure, there are traffic jams now and then but these are only mildly frustrating elements in our use of the automobile.

But from another point of view, the automobile is a dangerous weapon; collisions even at relatively slow speeds of 20–25 miles per hour often result in fatal accidents. National losses from automobile accidents are appallingly high; these losses are estimated at $5 billion annually, to say nothing of the human suffering involved. Almost every adult among us has lost a member of his family or a good friend as the result of an auto accident.

Need this situation continue? A realistic evaluation suggests that no amount of research, ingenuity, or enforcement effort will eliminate traffic accidents completely. Much progress has already been made in the design and construction of highways with the result that traffic moves faster and at the same time more safely. Great progress has also been made by manufacturers in designing and producing cars which rarely become involved in accidents because of mechanical failure. Some design progress has been made which reduces the seriousness of personal injuries in nonfatal auto accidents. The one great hope for improving the traffic safety picture, however, involves learning a great deal more than we now know about drivers in order that such knowledge may be used to reduce accident-conducive driver behavior. As contrasted with relatively large and expensive research programs on roads and on vehicles, as a Nation, we spend practically nothing on research on the human factors associated with accident-conducive behavior. The result is that, while almost everybody has a ready panacea for improving the situation (e. g., "lower horsepower," "better enforcement," "loss of license") we have practically no firm knowledge on which to base effective action programs for reducing traffic accidents.

A couple of months ago, I was privileged to serve as a member of a panel of scientists, representing a number of disciplines, which met under the auspices of the President's Committee on Traffic Safety, for the purpose of developing fresh approaches to the problems of traffic safety research. At the request of Mr. J. William Bethea, secretary of the President's Committee, I wish to introduce into the record the report and recommendations of this group of distinguished scientists; it is entitled "Special Report on the Williamsburg Conference."

Three broad programs of research were seen by this panel as urgently needed:

(*a*) A vigorous research effort aimed at measuring actual traffic dynamics and actual driver-car behavior in various traffic situations in order more clearly to delineate dangerous situations and to indicate ways whereby new road and automobile design and modified traffic rules can increase traffic flow and reduce traffic hazards.

(*b*) Intensive studies of driver behavior including not only those aspects of the immediate environment to which the driver reacts but also of background and personality factors which contribute to the manner in which he characteristically drives a car.

(*c*) Analyses of the place of the automobile in American life: driving as a social activity or game requiring conformity to socially defined rules whose violation constitutes antisocial behavior and as an economic activity involving choices between benefits and costs including the manner in which costs should be allocated (e. g., insurance.)

Here, I wish to quote a few of the more important conclusions of this panel of scientists:

"Despite the extensive work already done by individuals and organizations, the current supply of scientific findings is insufficient to provide a firm basis for public policy. The problem of traffic safety, like other important public health problems, demands large-scale support from private and public sources.

"*Research strategies.*—Encouragement should be given to basic as well as applied research. From advances that have occurred in the solution of other problems (in the fields of health and industry, for example) we are convinced that more effort must be devoted to basic or fundamental research.

"The phenomenon of highway accidents cannot be fully understood without considering it in the context of routine traffic behavior; hence research must include the study of normal as well as abnormal patterns of behavior.

"The nature of the problem makes it necessary that research be conducted both in suitable laboratory situations and in selected field situations (e. g., communities, sociocultural groups and other population segments). In many instances field research can be effective only with the cooperation of civil authorities and informal leaders.

"The promotion and support of research should be such that findings of the several appropriate research disciplines may be available for integration and application to the problem at hand.

"Research efforts both by groups and by individual workers should be encouraged. For best results, research should be supported on the longrange program basis as well as on a short-term project basis.

"To the extent possible, research should be conducted by organizations with a maximum of research talents and a minimum of inappropriate pressures."

The problem of improving traffic safety is an extremely complex one. There are many different kinds of accidents and any single accident usually has more than a single cause. It is my considered opinion that effective programs for reducing accidents will be possible only after carefully planned research on many fronts. Such research will require the best efforts of many groups of scientists over many years. Early and simple solutions are not probable. Yet the problems are so important to society that we must give financial support for the research which must be done.

Dr. McFARLAND. Thank you very much.

We have heard two distinguished psychologists talk on this subject.

Do you have a question?

Mr. ROBERTS. No, sir. I simply wanted to get this straight. The statements for the record of Dr. Dunlap and Dr. Kelly and Dr. Goddard, as well as the Williamsburg report, will be made a part of the record without objection on the part of the members of the subcommittee.

Dr. McFARLAND. Thank you very much.

Our next witness is Dr. Herbert S. Gaskill, who is professor and head of the department of psychiatry at the University of Colorado Medical School.

I think what the previous speakers pointed up is the fact that driver behavior is important so that we naturally look to the field of psychiatry and psychology for help. It is a great pleasure to introduce a man whose experience and knowledge in this subject is very, very good.

STATEMENT OF DR. HERBERT S. GASKILL, UNIVERSITY OF COLORADO, DENVER, COLO.

Dr. GASKILL. Dr. McFarland, Mr. Roberts, members of the committee, ladies and gentleman, our group at the University of Colorado, the driving survey group, are relatively new in this field. We have been engaged in it for approximately 5 years, so that our experience is rather limited compared to some of the others that you will hear from later. However, anyone who enters into this field immediately becomes aware of the complexities of the problem that one is dealing with.

While we are interested primarily in behavior; human behavior as it influences driving, we are certainly aware that our approach is only going to give a partial answer to the problem that you are seeking to solve this morning.

Now, I think it is only fair to say that when we talk about human factors it immediately becomes apparent that this is a very complex problem.

Those of us who are in clinical psychiatry and clinical psychology have been aware for years that there are such things as accident prone people, individuals who seem to repeatedly get into difficulty by having accidents.

On the other hand, in an effort to try to define what are the kinds of characteristics that one could use to predict what individuals fall into this category one runs into tremendous difficulties. It was our intention to try to review the literature as carefully as we could in regard to psychological and psychiatric factors in this field and we immediately became aware that driving in itself is a very complex phenomenon.

There are many different kinds of needs that the individual attempts to satisfy in the process of driving and in addition there are many complex symbolic meanings both conscious and unconscious which greatly influence how an individual drives.

The first phase of our study was to attempt to find a fairly large group of individuals who could be divided up into those who had high accident rates, those who had middle accident rates, and those who had no accidents.

We were working with just one Air Force base and this was a population of about 10,000, and we wish to emphasize the fact that as far as our own study is concerned we are using a limited segment of the population and we realize that our studies, therefore, are not applicable to the total spectrum of the population across the country.

What we attempted to do was to set up as many different kinds of psychological and psychiatric, psychophysical and psychological tests as we thought were pertinent in attempting to define who these individuals were.

We did our first study on approximately 106 of these individuals who were so defined, and I might point out that it took about 6 days to test 1 individual, which shows you the complexity of the number of tests that were involved.

It came out when we finished and tried to analyze our data we found that, of the various tests that we were using, probably the best thing that we had at that time in prediction which would predict about 73 percent of those who would fall into either the high accident or the nonaccident group was a study of values.

We then proceeded to cross validate this particular study.

We also had some other factors that we had found seemed to also indicate and we wanted to cross validate those.

Our second group was again a group of approximately another 100 individuals who fell into the 3 categories that I have indicated.

On the cross-validation a number of the tests that we had found in the early series dropped out but still the study of values continued to show some promise, and about at the same level of 73 percent.

Following this we were kind of puzzled because we were surprised. We had not expected that this study of values would be the thing that would give us the most data.

We wanted to see if we could define in more detail what the characteristics of these people were which did not appear quite as clearly in this study of values as we had thought.

We again selected 10 individuals from the high accident group and subjected these individuals to even a more extensive kind of battery, including psychiatric examination, psychologicals, and so on.

As a result of this we feel that as far as this particular group of the population is concerned, we can say certain things about the characteristics, and I will just try to enumerate them very briefly:

First of all, that they have less capacity for controlling and managing hostility.

Secondly, that they tend to be excessively self-centered.

Third, that they tend to be preoccupied with daydreams and to be impulsive.

Fourth, that they are more fearful of loss of love and support and faith, that they are more often characterized as being openly hostile and less often as being appropriately aggressive or nonassertive.

Now, we are continuing our study at the present time in one other phase.

We have now approximately 7,000 sophomore high-school students whom we have examined. We have given them certain tests. We also have the school records that these people have accumulated over a period of about 10 years, and we intend to follow these people for approximately 5 to 10 years, and we hope to do predictive studies in terms of whether these individuals will be accident prone or whether they won't.

We also hope to find out from this particular sample of young people what effect formal driver education has because some of them have been exposed to formal driver education and some have not.

We are curious to know whether the very fact that they take driver education may be in part determined by the kind of people, the kind of background they have.

In concluding, I should like to just stress 1 or 2 things:

First of all, that our study needs a great deal more broadening out. In other words, that while this high-school study will attempt to get at a wider segment of the population, still the kinds of studies that we have done need to be applied on a much wider basis than our particular study.

Secondly, it seems to us that one needs to know a great deal more about the fluctuations in terms of stresses that occur within the lives of individuals that make some individuals at some times more prone to have accidents and at other times less prone.

It is obvious that the accident repeater is only a small part of the problem. While he is responsible for many accidents in many instances the total accident problem, the greater part of it, is probably due to those who only have 1 accident or maybe at the most 2 accidents in the course of a lifetime.

Now, I think we also need to know a great deal more about accident prevention. What can we do in terms of modifying these traits of individuals who are accident-prone?

Work such as Tillman is doing along this line is very interesting and in the long run ought to be very rewarding.

A second area that seems to me to need a great deal of working on is what kind of changes in the environment can accomplish changes in accident rate. Dr. Dunlap and his associates have been working in

this area and again such things as shifts in morale increasing number of officers on a road, increasing punitive measures, punishing offenders, and so on.

What effect do these things have?

All of these need a great deal more study in trying to solve this problem.

Thank you very much.

(The statement follows:)

STATEMENT BY HERBERT S. GASKILL, PROFESSOR AND HEAD, DEPARTMENT OF PSYCHIATRY, UNIVERSITY OF COLORADO SCHOOL OF MEDICINE

The organization of this panel clearly indicates our conviction that motor vehicle accidents, or accidents of all types, are not, as the term implies, simply a function of chance. Accidents of all types, when their epidemiology is carefully studied, are found to result from the interaction of complex factors. In attempting to evaluate accidents, while it may be necessary for purposes of research to concentrate on one aspect of the problem or on a limited number of factors, the results of such research then must be seen in perspective as they relate to the total accident problem.

For years it has been a commonly accepted axiom that human behavior makes a significant contribution to the causation of accidents along with other factors. Psychiatrists and psychologists from their clinical practice, their observation of human behavior and their research activities have recognized the role which psychological attitudes, and emotions contribute to the causation of accidents. Despite this, it has been extremely difficult to precisely define the exact psychological characteristics which could be used as a predictive tool to identify individuals who might be chronic accident repeaters.

One has only to think of the complex factors which enter into driving to realize why such predictions are extremely difficult. Driving for each individual has many symbolically complex meanings both unconscious and conscious and may be used to gratify a wide variety of impulses and needs. To complicate matters further, we know that the mental and emotional state of the driver may vary widely, often within relatively brief periods of time. Such transient fluctuations are related to the character structure, motivation, and emotional reactions of the individual and to the immediate and chronic stresses to which he or she may be subjected. All of these factors hence are related to the possibility of a particular individual having an accident and makes the problem of predicting who may be an accident repeater very difficult.

A great deal of research has been done in an effort to determine whether accident repeaters possess unique personality characteristics which differentiate them from the nonaccident drivers. For example, in various studies accident and nonaccident drivers have been compared on a wide variety of (1) psychophysical and psychophysiological measures, such as reaction time, coordination, and depth perception; (2) on measures of personality structure and functioning; and (3) on social history variables. Many of these studies have yielded equivocal or contradictory results, probably partly because of real differences between the groups studied, but also in many cases because of methodological deficiencies in the design of the studies—including failure to control for variations in accident exposure, unreliability in the accident criteria employed, and lack of objectivity in the measurement of driver characteristics. The weight of the evidence, however, suggests that in most populations, accident repeaters are likely to differ from nonaccident drivers in their personal characteristics.

During the past 5 years our group at the University of Colorado School of Medicine has attempted to study the role of personal and interpersonal factors in determining accident frequency and severity in a limited population sample of 264 Air Force personnel stationed at 1 base. In general agreement with a number of other investigators, we have found that high-accident and accident-free drivers differ more in personality characteristics than in either psychophysical skills or psychophysiological conditions.

The data to date, for example, indicate that accident drivers, when compared to matched nonaccident controls, demonstrate a statistically significant tendency (1) to have less capacity for managing or controlling hostility; (2) to be excessively self-centered and indifferent to the rights of others; (3) to be

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either excessively preoccupied with daydreaming or to act impulsively with little or no reflection; (4) to be more fearful of loss of love and support; (5) and to be categorized more frequently as consistently or occasionally belligerent or covertly hostile; and less frequently as only appropriately assertive, or unassertive. These data while promising need further validation to determine their applicability to wider samples of the driver population.

In connection with this last point, we are engaged currently in a predictive study of approximately 7,000 15-year-old predrivers from a large urban and suburban area. This study includes an analysis of psychological tests, personal-social background and longitudinal behavior data, obtained before the individual begins to drive in order to determine whether nonsafe drivers can be identified before incurring accidents and/or violations. Included in this is an evaluation of formal driver education programs.

Obviously, additional research is necessary (*a*) to determine more precisely what basic personality characteristics are related to high-accident susceptibility in the population at large, and (*b*) to gain a better knowledge of the fluctuating, transient stresses and emotional states which make people more susceptible to accidents under certain circumstances and not under other conditions. This latter topic appears to be of prime importance in view of the fact that while a small group of drivers are chronic accident repeaters, the great majority of accidents are sustained by persons with no prior accident-violation record. However, relatively little systematic research has been conducted in this area to date, although fluctuation in accident susceptibility are commonly observed.

In addition to the above, however, there is a tremendous need for further research in the area of human factors and accident prevention. Studies are needed to provide answers to such questions as:

(1) To what extent can accidents be reduced by modifying the personality traits and attitudes of persons with high-accident potential; what kinds of traits and attitudes are most modifiable, by what techniques, and how feasible are these techniques from a practical point of view? For example, what are the relative values of various specific educational and psychotherapeutic approaches? Some pioneer work has been done in this area by investigators like Tillman, who is using group psychotherapy techniques with accident repeaters. However, much remains to be done.

(2) To what extent can accidents be reduced even in accident susceptible persons through environmental changes, i. e., improving morale, providing stiffer penalties for violators, etc.? Some of the work of Dunlap and others is relevant in this connection. Much additional research is urgently needed to increase our understanding of the relationship of human behavior to the problem of accidents.

UNIVERSITY OF COLORADO, SCHOOL OF MEDICINE,
DRIVER RESEARCH PROJECT.
HERBERT S. GASKILL, M. D.
JOHN J. CONGER, Ph. D.
ROBERT V. RAINEY, Ph. D.
WILLIAM L. SAWREY, Ph. D.
EUGENE S. TURRELL, M. D.

Dr. MCFARLAND. Thank you.

I am next going to call on Dr. Bobbitt, who is the Assistant Director of the National Institute of Mental Health. He comes to this subject from the field of psychology, and, from his vantage point, I think he will have something to contribute to us on the research needs in this area.

Dr. BOBBITT.

STATEMENT OF DR. JOSEPH M. BOBBITT, NATIONAL INSTITUTE OF MENTAL HEALTH, BETHESDA, MD.

Dr. BOBBITT. Mr. Moderator, Chairman Roberts, members of the committee, fellow panel members, and distinguished guests, it is indeed very valuable for research workers to have this opportunity to discuss with this committee the needs for research in the traffic accident field.

My remarks will be confined to the area of my own professional competence, psychology, and to the area of my activity, mental health.

I am not unaware at all of the very great contributions that have and can be made by engineers, legislators, educators, and enforcement officials, and the like. I will have to confine myself to the area which is closest to my interest and knowledge.

The driver is the least understood and least studied component in the traffic accident situation. It should not be concluded that psychologists have ignored him. As a matter of fact, they have studied him a great deal, but the results today, as other panel members have indicated, are not as gratifying as we might have hoped they would be.

On the basis of our knowledge to date we do know that psychomotor, psychophysical, sensory, and perceptual tests do not adequately discriminate between those who are likely to have a large number or a small number of accidents.

These findings are discouraging since these are the kinds of tests that are relatively easy to make, can be made quickly and with some precision and reliability.

On the other hand, there are indications that more complex characteristics of the individual are in fact significantly related to the person's probable and actual accident record.

People with poor employment records, a history of school truancy, a record of other than driving offenses, bad credit records, tend to have more accidents than they should. Young persons up to 30 have more than their share of accidents; also persons characterized by certain personality characteristics some of which Dr. Gaskill has mentioned. Aggressiveness, antisocial attitudes seem to contribute unduly to the accident record.

Then, too, there are the temporary conditions of the driver, such as those induced by alcoholic intoxication, fatigue, and emotional upset which seem to be related.

In other words, complex measures involving changes with age, biographical and personal history elements, personality characteristics, the social role of the driver, and so on, do provide interesting and provocative differences between the drivers with good and bad records.

These differences, though important, are not immediately usable for a variety of reasons.

First, the relationships between personality variables and accident records are not great enough to use them for purposes of individual prediction. Therefore, we cannot refuse to license people on the basis of these relationships.

Second, the accumulation of biographical and personal history data about such things as an individual's employment record and legal offenses must span his late adolescent and early adult life while he is already a member of the driving population and contributing to the accident statistics.

Third, while the lower age limit at which one may operate a car is subject to further careful study, it is evident that oncoming generations must be admitted to the driver population prior to the age of 30.

In view of this situation, one may properly ask, what the task of research in accident prevention is that must be undertaken by psychologists and other behavioral scientists and social scientists in fu-

ture years. Because of the need for brevity, I shall limit myself to some ideas concerning three general areas and I suspect that this is a sort of a report about how a psychologist might think about this problem; at least about how one psychologist, this one, might think about it.

First, it is imperative that we learn more of what lies behind some of the relationships that are beginning to become established. For example, what are the changes that occur between the ages of 15 and 30 years that result in better driving behavior? This is, of course, the part of the life span when one acquires a family, a vocation, a place in the community, and—it appears—a sense of responsibility and some commonsense about driving.

As a consequence of these observations, it appears that we might suggest that there is need for careful studies both cross sectional and longitudinal of personality development and change between the ages of 15 and 30 years to determine the nature and causes of the changes that occur in this part of the life span which result in better driving. These studies should be so conducted as to make it possible to correlate this development with the changes and factors influencing development in early childhood years.

Second, it would be very valuable to know why some of the social stigmata such as history of offenses against the law and bad credit ratings are related to poor accident records.

The best guess at present is that these measures, including the accident record, are different views of the same inadequacies of the personalities involved.

Just what these inadequacies are must be better determined than to date. One is tempted to view them as indicators of irresponsibility and immaturity. If this is the case, they may involve the experiences of childhood as well as those of the late adolescent and early adult years. Perhaps the increasing effort to understand delinquency and alcoholism, for example, are really as pertinent to accident prevention as are matters directly related to the car and to driving. Therefore, I would suggest that we should have studies of the relationship between driving behavior and a variety of ways in which the young adult develops his patterns of conformity to group norms and other behaviors that indicate his adult integration and his acceptance of responsibilities.

The total process of becoming mature is undoubtedly related to car driving, and the proper method of approaching the problem is that of studying the total set of phenomena rather than a thin slice of the development that is indicated by how one drives a car.

Thirdly, I would like to talk a little bit about the possibilities of rehabilitating the driver with a poor record.

There is evidence that compulsory driver training as a part of the penalty for driving offenses have some value. It appears that reeducation must go beyond better knowledge of the traffic laws and greater skill in operation of the car. My suggestion in this connection is that we need to explore the problem of rehabilitating the driver as we have begun to explore the problem of rehabilitating mental patients.

There is good evidence today that there are increasingly hopeful possibilities of keeping a discharged mental patient out of the hos-

pital if there is proper followup and community concern about his activities after he leaves the hospital.

It is my suggestion that the person who has been guilty of offenses with the automobile is no less rehabilitatable than the person who has had a mental illness.

I do think that the problem of driving a car badly and the whole pattern of behavior which the very bad driver has is a complicated business but if we can rehabilitate the mentally ill patient and keep him of of the hospital once he has been treated, I am sure there is a good possibility for rehabilitating the offending driver.

To do this, we need to study the records of such offenders on a continuing basis after they have had a variety of remedial efforts applied to their cases.

I would also like to express some concern about the problem of how the community handles the problem of the offending driver. It seems to me true that there is very little social censure or interpersonal punishment exacted of most drivers who have accidents. Except for a few instances, such as those involving violations in a school crossing or hit-and-run driving, there is more likely to be sympathy for the person involved in an accident than there is censure by his friends. Therefore, I would like to know the basis of the fact that one views his friend in such an indulgent manner when he has an accident. This is probably different from the way he views others.

It is easy enough to become angry at the driver who is described in a newspaper, but is very difficult to become angry at the driver who has an accident and who turns out to be one's friend. We do know quite well that people conform pretty thoroughly, most people, to the norms and the requirements of their own interpersonal face-to-face group.

I would, therefore, like to see the social scientists, anthropologists, and social psychologists study the problem of why driving behavior is evaluated as it is and as indulgently as it is by the people in our society.

When we begin to understand the process whereby the degree of seriousness is attributed to behaviors of this kind, then possibly we can do something with the task of increasing the social pressure which people bring upon people to drive better.

I hope that I have indicated that this problem is complex but it is in fact approachable from a research point of view and the way the solution lies is work and more work.

Thank you.

(The statement follows:)

Approaches to Accident Prevention Through Driver Oriented Research

Joseph M. Bobbitt, Ph. D.[1]

Those who are conversant with traffic safety problems will agree that there is need for an increase in the amount and quality of research directed toward the prevention of automobile accidents. However, it should be made clear at the outset that this is not a field that has been badly neglected. In point of fact, a tremendous contribution has been made to traffic safety over the last three decades by improvements in the roadway, the vehicle, enforcement procedures, administrative control through improved licensing and vehicle inspection require-

[1] Assistant Director, National Institute of Mental Health, National Institutes of Health, Public Health Service, Department of Health, Education, and Welfare, Bethesda, Md.

ments, improved legal codes, educational efforts, and other advances derived from study. Large numbers of individuals and organizations, both public and private, have worked hard and effectively so that what is known about accidents and their prevention can be applied in today's mechanized world.

The record shows that the rate at which fatal accidents occur on our highways has decreased, when either vehicle-miles or passenger-miles are used as indexes. However, the number of vehicles and the number of miles driven have increased so greatly that the improved accident rate has been just about offset by the increased amount of driving. The actual number of persons killed annually in traffic accidents in the midthirties and in 1957 are just about equal. If the rate for fatal accidents had not dropped, there would have been an even larger and more tragic figure on the record books for 1957 than was actually the case.

With respect to the future, it is clear that the number of cars on our roads will continue to increase steadily. New and improved road systems will contribute to an increase in the number of miles driven. These facts make it more than ever apparent that the country cannot afford to permit a continuation of the present rate of accidents, because the result will be a marked increase in the absolute toll of lives.

This committee is hearing today the suggestions of experts in all of the relevant areas that can contribute to a reduction of the loss of lives, injury, and property, resulting from traffic accidents. My own field of professional competence is psychology, and my field of work for the last 12 years has been the mental-health area. Thus, my interest in traffic accidents centers in the problems associated with the driver, as distinguished from the problems associated with the roadway, the vehicle, law enforcement, and other important aspects of the problem.

The driver is the least understood and least studied component of the traffic-accident problem, but it should not be concluded that psychologists and other behavorial scientists have ignored the driver. The moderator of this panel, Dr. Ross McFarland, and his coworkers, Drs. Roland C. Moore and A. Bertrand Warren,[2] for example, have produced an excellent summary of the extensive literature on the subject, showing the influences related to more or less stable characteristics of drivers, as well as those related to temporary conditions of the driver. They have also reviewed the effectiveness of training programs in this field and research results concerning a variety of associated variables and factors.

It is known today that sensory and psychomotor measures, such as sensory acuity, motor coordination, and perceptual tests, are not particularly useful in accessing the likelihood that one will or will not have an undue number of accidents. This is discouraging because they involve the kinds of measures that can be made rather quickly and with a fair degree of precision and reliability. There is need for additional effort to improve such measurement methods and most of all for studies through which the combined influence of several of these factors is assessed. It appears fair to say, though, that the behavioral scientists will not be able to make a major contribution to accident prevention without going beyond the concepts and methods involved in the sensory and psychomotor approaches.

On the other hand there are indications that some much more complex characteristics of drivers are related to their accident records. Young drivers up to about 30 years of age have more than their share of accidents. People with poor employment records, a history of school truancy, a record of other than driving offenses, credit difficulties, etc., appear to have poor accident records. Persons characterized by aggressiveness and antisocial attitudes are likely to have high accident rates. Then, too, accidents are definitely related to temporary conditions of the driver such as alcoholic intoxication, fatigue, emotional upset.

In other words, while simple, easily made psychological and psychomotor measures of stable characteristics do not discriminate in a highly useful way between those with good and poor driving records, more complex measures involving changes with age, biographical and personal history elements, personality characteristics, the social role of the driver, and so on, are more likely to provide some interesting and provocative differences. These differences, too, while important, are not immediately usable for a variety of reasons. First, the relationships between personality variables and accident records are not great enough to use them for the purpose of individual prediction. Second, the accumulation of biographical and personal history data about such things as an

[2] Drs. Ross D. McFarland, Roland C. Moore, A. Bertrand Warren, Human Variables in Motor Vehicle Accidents, a Review of the Literature, Harvard School of Public Health, Boston, 1955.

individual's employment record and legal offenses must span his late adolescent and early adult life while he is already a member of the driving population and contributing to the accident statistics. Third, while the lower age limit at which one may operate a car is subject to further careful study, it is evident that oncoming generations must be admitted to the driver population prior to the age of 30.

What, then, is the future task of research in accident prevention to be undertaken by the psychologists and other behavioral and social scientists? Because of the need for brevity, the suggestions will be limited to three broad areas of challenge.

First, it is imperative that we learn more of what lies behind some of the relationships that are beginning to become established. For example, what are the changes that occur between the ages of 15 and 30 years that result in better driving behavior? This is, of course, the part of the life span when one acquires a family, a vocation, a place in the community, and—it appears—a sense of responsibility and some commonsense about driving. However, little is known about what experiences occur in this 15-year interval that produce the relatively safe middle-aged driver. Are there ways that these changes can be accelerated? The answer is probably in the affirmative, but the research task is a difficult one.

It would also be highly valuable to know why some of the social stigmata, such as a history of offenses against the law and bad credit ratings, are related to poor accident records. The best guess at present is that these measures, including the accident record, are different views of the same inadequacies of the personalities involved. Just what these inadequacies are must be better determined than they have been to date. One is tempted to view them as indicators of irresponsibility and immaturity. If this be the case, the corrective measures may involve the experiences of childhood as well as those of the late adolescent and early adult years. Perhaps the increasing efforts to understand delinquency and alcoholism, for example, are really as pertinent to accident prevention as are matters directly related to the car and driving.

Second, what are the possibilities of rehabilitating the driver with a poor record? There is evidence that compulsory driver training as a part of the penalty for driving offenses has some value. It appears, however, that the reeducation must go beyond better knowledge of the traffic law and greater skill in the operation of the car. There must be study of the possibility of changing the basic attitudes of offending drivers to the point that they do not act out their problems with the automobile. Whether or not such objectives can be reached at a reasonable cost and in a way that can affect large numbers is a major problem of research in the accident field. Findings from such rehabilitation studies would have tremendous value for increasing the preventive value of original driver training.

Finally, it appears desirable to learn more about the way accidents are viewed and handled by the community. Except for a few kinds of offenses, such as hit-and-run accidents, or those involving a school crossing, the driver who has an accident receives very little censure at the level of his daily interpersonal experience. There seems to be little real social punishment for bad driving and relatively little reward for a good driving record. It is well known that most people conform to the requirements of behavior set by their peer groups and the dominant groups of the community. One feels that these forces have really not been mobilized around the accident problem. It is fair to ask the social psychologists and other social scientists how this weight of public opinion can be mobilized for effective influence on the side of safety.

The above discussion leads to the following specific suggestions concerning major research areas that require attention:

1. There is a need for careful studies, both cross sectional and longitudinal, of personality development and change between the ages of 15 and 30 years to determine the nature and causes of the changes that occur in this part of the life span and which result in better driving. These studies should be conducted in such a manner as to take into account the influences upon development during this period (15 to 30 years) of previous childhood experiences.

2. Studies should be conducted of the relationship between driving behavior and a variety of ways in which the young adult develops his patterns conformity to group norms and other behaviors that indicate his adult integration and his acceptance of responsibility. The total process of becoming mature is undoubtedly related to car driving, and the proper method

of approaching the problem is that of studying the total set of phenomena rather than a thin slice of the development that is indicated by how one drives a car. If one understands the total early adult maturing process it may be possible to facilitate and hasten it with benefits accruing to the driving problem as well as to many other fields of human interaction.

3. Work is needed that will help society deal with the problem of the driver who has shown inadequate or irresponsible characteristics. One of the developing areas of great promise in the mental health field today is the effort to study the experiences of discharged mental hospital patients in order to prevent relapse. There is definite evidence that this task is possible with the recovered mental patient. It appears reasonable that the future prospect of the offending driver is equally hopeful. What is needed is carefully planned and executed studies of the continuing experience of offending drivers as influenced by a variety of remedial efforts.

4. Broad studies are needed to determine how the community and social groups determine the degree of seriousness with which various behaviors are viewed. The fact that most driving offenses by one's friends are viewed with some tolerance is a real puzzle. Further, there tends to be sympathy rather than censure for one's friend who is involved in an accident. Survey studies of attitudes toward driving offenses upon the part of one's friends as contrasted with those upon the part of others may give some insights into why face to face groups do not bring great conformity pressure to bear in the driving area.

These brief remarks may give some indication of the importance of further research on the driver in an effort to reduce traffic accidents. I regret that there has been time to mention but a few of many promising leads which remain to be explored. I will have served my purpose, however, if I have conveyed that in the field of traffic accidents as in all fields of health, education, and welfare, research leading to new knowledge which can be broadly applied is the key to progress.

Dr. McFarland. Thank you very much.

We now have four panelists from the field of clinical and industrial medicine. Two of them unfortunately, through reasons beyond their control, were not able to come, Dr. Paul Dudley White, the cardiologist from Boston, and Dr. Hedwig Kuhn, the ophthalmologist from Hammond, Ind. Both of them have prepared statements which will be submitted to you later, Mr. Roberts.

I am next going to call on Dr. Fletcher Woodward. Dr. Woodward is chairman of the committee on medical aspects of automobile injuries and deaths, of the American Medical Association, and is a distinguished physician from Charlottesville, Va.

Dr. Woodward.

STATEMENT OF DR. FLETCHER D. WOODWARD, CHAIRMAN, COMMITTEE ON MEDICAL ASPECTS OF AUTOMOBILE INJURIES AND DEATHS OF THE AMERICAN MEDICAL ASSOCIATION, CHARLOTTESVILLE, VA.

Dr. Woodward. Mr. Chairman, members of the committee, Mr. Moderator, members of the panel, as Dr. Ross McFarland has said, I am from Charlottesville, where I am engaged in the private practice of medicine and also serve on the faculty of the University of Virginia School of Medicine.

I am chairman of the committee on medical aspects of automobile injuries and deaths, of the American Medical Association, and am appearing today on behalf of that association. I would like first to express my appreciation for this opportunity to appear before you to tell you something of what the American Medical Association is trying to accomplish in the field of traffic safety and accident prevention.

The American Medical Association has been concerned with the problem of automobile injuries and deaths for many years. Actions of our house of delegates on this subject are numerous and date back as far as 1929. In 1948, our house passed the following resolution:

> Whereas the American Medical Association has in the past cooperated with the National Safety Council in its efforts to reduce the incidence of deaths and injuries from accidental causes; and
>
> Whereas the studies that have been made by the Bureau of Medical Economic Research of the American Medical Association have established the fact that fatal accidents cut off more years from the working lifetime of the American people than any one natural cause of death; and
>
> Whereas, in the recent report made to the President by the Administrator of the Federal Security Agency, it was stated that 40,000 deaths annually from accidents were preventable: Therefore be it
>
> *Resolved*, That the board of trustees be instructed to cooperate in every possible way with the National Safety Council and with every other agency, both public and private, concerned with accident prevention, to the end that research in accident prevention be further stimulated; that this excessive drain on hospital and medical facilities be lessened, and that the appalling loss of working years be reduced.

For more than 30 years our association has had committees actively working on the various aspects of the automobile accident problem. The present committee was appointed by our board of trustees in 1955. Its members are chosen from physicians who by their interest and work were considered to be well qualified in this field.

We believe most people will agree that those who are called upon night and day to pronounce dead those persons killed on our highways, and who mend the broken bodies of those who are injured, can well be classified as interested and qualified in their efforts to prevent such carnage. Within the lifetime of most of us here, we have seen substantial gains by the medical and allied health professions in the conquest of disease and disability. Many of the diseases that were commonplace early in this century have been conquered or brought under effective control. Many diseases that were once widespread are now a rarity. However, accidental injuries and disabilities due to automobile accidents have become the No. 1 public health problem of our time. We believe it is important, therefore, that the medical profession continue to increase its interest in the automobile accident problem until effective improvement is a reality.

As the result of our studies, we are convinced that if speed, recklessness, and drunken driving are controlled, and if improvements in automobile design are provided to protect those involved in collisions, then the present appalling toll of injuries can be substantially reduced. We are further convinced that enough facts are at hand to accomplish this purpose now.

My statement will consist of a delineation of the several objectives of the American Medical Association's committee on medical aspects of automobile injuries and deaths, and a discussion of past, present, and planned activities in each case.

One of our most important objectives is to provide the practicing physician with technical medical information which will enable him to advise and inform his patients relative to driving limitations that may be involved in:

(*a*) Physiological states.
(*b*) Pathological conditions.
(*c*) Emotional disturbances

(*d*) Drugs and alcohol, et cetera.

We realize that a certain percentage of accidents are undoubtedly caused directly or indirectly by medical conditions, drugs, and other related physical factors and that it should be our first duty to clean our own house. To this end we sponsored a symposium on medical aspects of automobile injuries and deaths and presented it at the association's annual meeting in June 1956 in Chicago. These papers were published in the Journal of the American Medical Association on January 26, 1957 (vol. 163, No. 4, pp. 225–262). Reprints are available and copies will be furnished to members of your comittee.

Our next objective is to prepare a comprehensive book to serve as a guide to physicians in determining fitness to drive as related to the medical background of the individual. This book, I am happy to say, has been completed and we hope will be off the press sometime in the next few months.

Closely related to the need for factual information to aid the physician is the need to inform the driving public through use of proper media of the medical conditions which may affect their driving proficiency. We believe that many individuals would voluntarily discontinue or diminish radically their driving if they understood the dangerous possibilities involved in certain physical disorders and the potential effects of certain medications. In other words, if we supplement the technical information furnished the physician with a pamphlet written at the proper level and covering the more commonly encountered medical situations, the patient can have the advantage of something in print which will serve to instruct him as to whether he should or should not drive; and, if so, under what safeguards. It is contemplated that this information as well as the data for physicians will be published in the Journal of the American Medical Association.

I would like to report that this particular pamphlet has been completed and we will be glad to furnish a copy of this with the report when you ask for it.

There is little doubt that a great deal of attention must be given to the very serious question of who shall be permitted to drive an automobile and who shall be denied that privilege. We emphasize that driving should be a privilege rather than a right. Therefore, our third objective is to develop better medical standards for driver licensing, including preparation of a guide for license examiners and assistance to State agencies concerned with licensing. This will be based on the information compiled in the medical criteria mentioned earlier and will constitute our recommendations for State licensing agencies. We recommend that each State medical society have a committee on traffic safety. Such committees would be in a position to advise and assist State driver licensing bodies in the improvement of medical standards for licensing.

Another objective is to study and report on the design features of automobiles. In improvement of the design and safety equipment of automobiles rests the greatest possibility for rapid reduction in the automobile injury and death toll. If it is estimated that the average life of an automobile is 10 years, it is apparent that a very considerable reduction in the severity of injuries and a marked reduction in fatalities could be accomplished in that time, if more attention were devoted to providing safety rather than to increased horsepower, streamlining, color, and chrome.

On the other hand, it will probably take a long time to engineer maximum safety into our major highways. It must also be recognized that on the secondary roads maximum safety in design may never be economically feasible. We would hesitate to forecast how long it will take to inculcate safe-driving practices, attitudes, and proficiency into 75 or 100 million drivers.

The engineers and the designers of the automobile—a relative handful of men in the industry—virtually control the destines of the American public on the highways. They are the men who decide which elements of safety design will be put into or left out of next year's new automobile.

There is presently available an ample body of research data which clearly indicates the definite values of certain safety features of automobile design, construction, and equipment. Yet, these safety features are all too often made available as optional equipment at extra cost. The automobile industry can make a great contribution toward solution of this problem by consulting with physicians, anthropologists, psychologists, related biological scientists, and other scientific professions, and by giving realistic consideration to the wide range of physical characteristics of automobile drivers and riders and what happens to them in a collision.

In the past the automobile industry has made many important contributions to safety. However, in recent years, safety has generally been ignored in favor of other developments. The following suggestions have been repeatedly advanced by physicians, researchers, and safety engineers with but little success:

1. Anchorage for seat belts should be standard equipment. The public also needs education in the value of seat belts. The only evidence so far presented against seat belts is in the number of deaths in sports cars during rollovers. This is not an argument against seat belts but against the design of such cars which do not provide rollover bars. It should be quite simple to incorporate such a bar in the windshield and a second one back of the seat.

2. Crash padding of the dash, roof, and other areas should be provided.

3. An improved steering wheel and recessed post; perhaps a collapsible assembly—I have been told it could not be done and yet I saw a foreign car the other day that provided such steering assembly.

4. Safety door locks should be standard in all cars.

5. Removal of dangerous knobs, buttons, sharp edges, and other gadgets.

6. Seats should be securely anchored to the floor of the car and should be locked into position. They should also be high enough in the center to protect the neck in a rear-end impact and prevent neck-snap injury (also called whiplash).

7. Eliminate the deck behind the car seat as a storage place for flying missiles or provide it with an effective retaining rail or construct it as a recessed pocket.

8. Eliminate sharp, pointed hood ornaments. These fill no functional need and are potentially lethal to pedestrians.

9. Eliminate other hazardous exterior design features such as sharp, pointed bumper ornaments.

In addition, we feel that the automobile industry should make an open-minded examination of other suggestions and adopt them where feasible. For example:

Shock-absorbing bumpers; if one drives his car into a brick wall at 1 mile per hour, he will be astounded at the shock transmitted by such an impact. One person testifying before your committee intimated that to absorb the energy at 20 miles per hour in a 4,000-pound car, such a bumper would have to be 16 feet long. I am not an engineer, but it seems to me that engineers are ingenious enough to provide practical, energy-absorbing bumpers, especially at the front end, and possibly at the rear as well.

Consideration should be given to the design of windshield and rear windows to meet standards based on optical principles.

Provide protective sideswipe bumpers along the sides.

Provide warning reflectors on the sides.

Remove taillights from the realm of the artistic designer.

Provide a positive separation of turn signal lights from other lights.

Eliminate the glare-reflecting surfaces on the interior.

Provide accurate speedometers. Why do we have speedometer dials indicating up to 120 miles per hour? Why not an audible warning device to denote when safe speed has been passed?

Construct drivers' seats with better regard for the posture and visibility of persons of various heights.

Make chrome, clocks, radiator ornaments, and other expensive gadgets optional equipment and install safety equipment as standard equipment.

As evidence of the interest in this subject by the entire medical profession and the conviction that something constructive can and should be done toward the prevention of injuries, I wish to quote a resolution adopted by the house of delegates of the American Medical Association at its meeting in Boston on December 1, 1955:

> Whereas traffic accidents in the United States claim 38,000 lives and 1,250,000 injured each year, with a probable 45-percent increase in vehicle mileage in the next 10 years; and
>
> Whereas this death and accident toll could be materially reduced through improvement in automotive safety design and construction; and
>
> Whereas all other modes of public transportation except automobiles are already safeguarded by Federal safety standards: Therefore be it
>
> *Resolved*, That the American Medical Association, through its house of delegates, strongly urges the President of the United States to request legislation from Congress authorizing the appointment of a national body to approve and regulate safety standards of automobile construction.

On January 9, 1956, Dr. George F. Lull, secretary and general manager of the association, addressed a letter to President Eisenhower in which he directed attention to the resolution.

The next objective of our committee is to promote the extension of emergency first-aid training to as many citizens as possible. This training will be of value not only in connection with the reduction of the severity of automobile crash injuries, but also in connection with civil-defense needs as well. We feel it is also desirable that all automobiles be equipped with first-aid kits.

Related to first aid is another objective—to assist in the promulgation and to promote the use of standards for organized emergency services in local communities, including training of rescue squads and standardized equipment for rescue vehicles. This is a future activity

in which we will work through State and county medical societies. An example of one problem in this area is the need for better selection, education, and control of drivers of emergency vehicles. There are cases on record of ambulance drivers speeding and screaming through heavy traffic when carrying a corpse to a morgue.

As citizens and physicians, we recognize the importance of driving courses for all high-school students. Similar courses should be provided for the public and the curriculum should meet certain basic educational requirements. We sincerely hope the day will soon come when such certificates will be required of all prospective drivers as well as for repeat traffic-law violators.

We intend to invite representatives from all State medical societies to meet with us in San Francisco in June 1958, at the time of the annual meeting of the American Medical Association. At that time, we plan to recommend a uniform group of objectives for the consideration of the State medical societies.

Since speed and driving under the influence of alcohol and their related offenses are intimately associated, we feel that stricter laws than any that now exist on our statute books should be provided. The public needs to be aroused to the point whereby the legislators will provide these laws and the traffic courts will administer them without fear and with complete impartiality.

Because of the indefatigable work of many safety organizations over the years, the incidence of death has been greatly reduced in spite of the tremendous increase in the number of vehicles and number of miles traveled. The present figure of 6.4 deaths for 100 million miles traveled is now nearly a static figure. In spite of this apparent success as to the incidence rate, the total number of deaths and injuries is increasing each year. Unless some of the suggestions mentioned above are followed, it seems inevitable that this number will continue to increase each year in spite of all the splendid work now being done.

Gentlemen, that concludes my statment. I thank you for your attention.

(The documents follow:)

STATEMENT OF THE AMERICAN MEDICAL ASSOCIATION RE MEDICAL ASPECTS OF THE AUTOMOBILE ACCIDENT PROBLEM

By Fletcher D. Woodward, M. D.

Mr. Chairman and members of the committee, I am Dr. Fletcher D. Woodward, of Charlottesville, Va., where I am engaged in the private practice of medicine and also serve on the faculty of the School of Medicine of the University of Virginia.

I am chairman of the committee on medical aspects of automobile injuries and deaths of the American Medical Association and am appearing today on behalf of that association. I would like first to express my appreciation for this opportunity to appear before you to tell you something of what the American Medical Association is trying to accomplish in the field of traffic safety and accident prevention.

The American Medical Association has been concerned with the problem of automobile injuries and deaths for many years. Actions of our house of delegates on this subject are numerous and date back as far as 1929. In 1948, our House passed the following resolution:

"Whereas the American Medical Association has in the past cooperated with the National Safety Council in its efforts to reduce the incidence of deaths and injuries from accidental causes; and

"Whereas the studies that have been made by the bureau of medical economic research of the American Medical Association have established the fact that fatal accidents cut off more years from the working lifetime of the American people than any one natural cause of death; and

"Whereas in the recent report made to the President by the Administrator of the Federal Security Agency, it was stated that 40,000 deaths annually from accidents were preventable: Therefore be it

"*Resolved,* That the board of trustees be instructed to cooperate in every possible way with the National Safety Council and with every other agency, both public and private, concerned with accident prevention, to the end that research in accident prevention be further stimulated; that this excessive drain on hospital and medical facilities be lessened, and that the appalling loss of working years be reduced."

For more than 30 years our association has had committees actively working on the various aspects of the automobile-accident problem. The present committee was appointed by our board of trustees in 1955. Its members are chosen from physicians who by their interest and work were considered to be well qualified in this field.

We believe most people will agree that those who are called upon night and day to pronounce dead those persons killed on our highways, and who mend the broken bodies of those who are injured, can well be classified as interested and qualified in their efforts to prevent such carnage. Within the lifetime of most of us here, we have seen substantial gains by the medical and allied health health professions in the conquest of disease and disability. Many of the diseases that were commonplace early in this century have been conquered or brought under effective control. Many diseases that were once widespread are now a rarity. However, accidental injuries and disabilities due to automobile accidents have become the No. 1 public-health problem of our time. We believe it is important, therefore, that the medical profession continue to increase its interest in the automobile-accident problem until effective improvement is a reality.

As the result of our studies, we are convinced that if speed, recklessness, and drunken driving are controlled, and if improvements in automobile design are provided to protect those involved in collisions, then the present appalling toll of injuries can be substantially reduced. We are further convinced that enough facts are at hand to accomplish this purpose now.

My statement will consist of a delineation of the several objectives of the American Medical Association's committee on medical aspects of automobile injuries and deaths, and a discussion of past, present, and planned activities in each case.

One of our most important objectives is to provide the practicing physician with technical medical information which will enable him to advise and inform his patients relative to driving limitations that may be involved in—

(*a*) Physiological states;
(*b*) Pathological conditions;
(*c*) Emotional disturbances; and
(*d*) Drugs and alcohol, etc.

We realize that a certain percentage of accidents are undoubtedly caused directly or indirectly by medical conditions, drugs, and other related physical factors and that it should be our first duty to clean our own house. To this end we sponsored a symposium on medical aspects of automobile injuries and deaths and presented it at the association's annual meeting in June 1956 in Chicago. These papers were published in the Journal of the American Medical Association on January 26, 1957 (vol. 163, No. 4, pp. 225–262). Reprints are available and copies will be furnished to members of your committee.

Our next objective is to prepare a comprehensive book to serve as a guide to physicians in determining fitness to drive as related to the medical background of the individual. When completed, this book will represent a compilation of medical data and the opinions of nationally recognized authorities in the various special fields of medical practice. With this information available, it should be possible for the individual physician to make a significant contribution to the welfare of his personal patients and the public at large.

Closely related to the need for factual information to aid the physician is the need to inform the driving public through use of proper media of the medical conditions which may affect their driving proficiency. We believe that many individuals would voluntarily discontinue or diminish radically their driving if they understood the dangerous possibilities involved in certain physical disorders and the potential effects of certain medications. In other words, if we supple-

ment the technical information furnished the physician with a pamphlet written at the popular level and covering the more commonly encountered medical situations, the patient can have the advantage of something in print which will serve to instruct him as to whether he should or should not drive; and, if so, under what safeguards. It is contemplated that this information as well as the data for physicians will be published in the Journal of the American Medical Association.

There is little doubt that a great deal of attention must be given to the very serious question of who shall be permitted to drive an automobile and who shall be denied that privilege. We emphasize that driving should be a privilege rather than a right. Therefore, our third objective is to develop better medical standards for driver licensing, including preparation of a guide for license examiners and assistance to State agencies concerned with licensing. This will be based on the information compiled in the medical criteria mentioned earlier and will constitute our recommendations for State licensing agencies. We recommend that each State medical society have a committee on traffic safety. Such committees would be in a position to advise and assist State driver licensing bodies in the improvement of medical standards for licensing.

Another objective is to study and report on the design features of automobiles. In improvement of the design and safety equipment of automobiles rests the greatest possibility for rapid reduction in the automobile injury and death toll. If it is estimated that the average life of an automobile is 10 years, it is apparent that a very considerable reduction in the severity of injuries and a marked reduction in fatalities could be accomplished in that time, if more attention were devoted to providing safety rather than to increased horsepower, streamlining, color, and chrome.

On the other hand, it will probably take a long time to engineer maximum safety into our major highways. It must also be recognized that on the secondary roads maximum safety in design may never be economically feasible. We would hesitate to forecast how long it will take to inculcate safe-driving practices, attitudes, and proficiency into 75 million or 100 million drivers.

The engineers and the designers of the automobile—a relative handful of men in the industry—virtually control the destinies of the American public on the highways. They are the men who decide which elements of safety design will be put into or left out of next year's new automobile.

There is presently available an ample body of research data which clearly indicates the definite values of certain safety features of automobile design, construction, and equipment. Yet, these safety features are all too often made available as optional equipment at extra cost. The automobile industry can make a great contribution toward solution of this problem by consulting with physicians, anthropologists, psychologists, related biological scientists, and other scientific professions, and by giving realistic consideration to the wide range of physical characteristics of automobile drivers and riders and what happens to them in a collision.

In the past the automobile industry has made many important contributions to safety. However, in recent years safety has generally been ignored in favor of other developments. The following suggestions have been repeatedly advanced by physicians, researchers, and safety engineers with but little success:

1. Anchorage for seat belts should be standard equipment. The public also needs education in the value of seat belts. The only evidence so far presented against seat belts is in the number of deaths in sports cars during rollovers. This is not an argument against seat belts but against the design of such cars which do not provide rollover bars. It should be quite simple to incorporate such a bar in the windshield and a second one back of the seat.
2. Crash padding of the dash, roof, and other areas should be provided.
3. An improved steering wheel and recessed post: perhaps a collapsible assembly. I have been told it could not be done and yet I saw a foreign car the other day that provided such steering assembly.
4. Safety door locks should be standard in all cars.
5. Removal of dangerous knobs, buttons, sharp edges, and other gadgets.
6. Seats should be securely anchored to the floor of the car and should be locked into position. They should also be high enough in the center to protect the neck in a rear-end impact and prevent neck-snap injury (also called whiplash).

7. Eliminate the deck behind the rear seat as a storage place for flying missiles or provide it with an effective retaining rail or construct it as a recessed pocket.

8. Eliminate sharp, pointed hood ornaments. These fill no functional need and are potentially lethal to pedestrians.

9. Eliminate other hazardous exterior design features such as sharp, pointed bumper ornaments.

In addition, we feel that the automobile industry should make an open-minded examination of other suggestions and adopt them where feasible. For example:

1. Shock-absorbing bumpers. If one drives his car into a brick wall at 1 mile per hour, he will be astounded at the shock transmitted by such an impact. One person testifying before your committee intimated that to absorb the energy at 20 miles per hour in a 4,000-pound car, such a bumper would have to be 16 feet long. I am not an engineer, but it seems to me that engineers are ingenious enough to provide practical, energy-absorbing bumpers, especially at the front end, and possibly at the rear as well.

2. Polarized headlight lenses and an oppositely polarized windshield spot. This has been repeatedly suggested and I have yet to see any reasons presented as to why it should not be adopted. It would prevent glare at night and thereby prevent many pedestrian accidents and deaths.

3. Consideration should be given to the design of windshield and rear windows to meet standards based on optical principles.

4. Provide protective sideswipe bumpers along the sides.

5. Provide warning reflectors on the sides.

6. Remove tail lights from the realm of the artistic designer.

7. Provide a positive separation of turn signal lights from other lights.

8. Eliminate the glare-reflecting surfaces on the interior.

9. Provide accurate speedometers. Why do we have speedometer dials indicating up to 120 miles per hour? Why not an audible warning device to denote when safe speed has been passed?

10. Construct drivers' seats with better regard for the posture and visibility of persons of various heights.

11. Make chrome, clocks, radiator ornaments and other expensive gadgets optional equipment and install safety equipment as standard equipment.

As evidence of the interest in this subject by the entire medical profession and the conviction that something constructive can and should be done toward the prevention of injuries, I wish to quote a resolution adopted by the house of delegates of the American Medical Association at its meeting in Boston on December 1, 1955:

"Whereas traffic accidents in the United States claim 38,000 lives and 1,250,000 injured each year, with a probable 45 percent increase in vehicle mileage in the next 10 years; and

"Whereas this death and accident toll could be materially reduced through improvement in automotive safety design and construction; and

"Whereas all other modes of public transportation except automobile are already safeguarded by Federal safety standards; Therefore, be it

"*Resolved*, That the American Medical Association, through its house of delegates, strongly urges the President of the United States to request legislation from Congress authorizing the appointment of a national body to approve and regulate safety standards of automobile construction."

On January 9, 1956, Dr. George F. Lull, secretary and general manager of the association, addressed a letter to President Eisenhower in which he directed attention to the resolution.

The next objective of our committee is to promote the extension of emergency first-aid training to as many citizens as possible. This training will be of value not only in connection with the reduction of the severity of automobile crash injuries, but also in connection with civil-defense needs as well. We feel it is also desirable that all automobiles be equipped with first-aid kits.

Related to first aid is another objective—to assist in the promulgation and to promote the use of standards for organized emergency services in local communities, including training of rescue squads and standardized equipment for rescue vehicles. This is a future activity in which we will work through State and county medical societies. An example of one problem in this area is the need for better selection, education, and control of drivers of emergency vehicles. There are cases on record of ambulance drivers speeding and screaming through heavy traffic when carrying a corpse to a morgue.

As citizens and physicians, we recognize the importance of driving courses for all high school students. Similar courses should be provided for the public and the curriculum should meet certain basic educational requirements. We sincerely hope the day will soon come when such certificates will be required of all prospective drivers as well as for repeat traffic law violators.

We intend to invite representatives from all State medical societies to meet with us in San Francisco in June 1958, at the time of the annual meeting of the American Medical Association. At that time, we plan to recommend a uniform group of objectives for the consideration of the State medical societies.

Since speed and driving under the influence of alcohol and their related offenses are intimately associated, we feel that stricter laws than any that now exist on our statute books should be provided. The public needs to be aroused to the point whereby the legislators will provide these laws and the traffic courts will administer them without fear and with complete impartiality.

Because of the indefatigable work of many safety organizations over the years, the incidence of death has been greatly reduced in spite of the tremendous increase in the number of vehicles and number of miles traveled. The present figure of 6.4 deaths for 100 million miles traveled is now nearly a static figure. In spite of this apparent success as to the incidence rate, the total number of deaths and injuries is increasing each year. Unless some of the suggestions mentioned above are followed, it seems inevitable that this number will continue to increase each year in spite of all the splendid work now being done.

That concludes my statement, Mr. Chairman. I shall be glad to attempt to answer any questions that the committee may have.

Dr. McFARLAND. Thank you very much, Dr. Woodward.

I understand from the chairman, Mr. Roberts, that the subcommittee will have to be in the House in session this afternoon and that we cannot continue through the afternoon.

Mr. ROBERTS. Doctor, that is subject to qualification. I think there is an educational bill on the floor that may be controversial and it may be possible for us to run until 12:30 or 1 o'clock.

I would appreciate if the panelists could cut their statements so that we will have some time left for discussion.

Dr. McFARLAND. We could call on each person for a short statement and then their prepared statement placed in the record.

Mr. ROBERTS. I regret that situation but you understand that these things are not subject to my control and we have to comply with what the Speaker wants to do.

Dr. McFARLAND. Next I will call on Dr. Brandaleone to give his report from the point of view of industrial medicine. He has been very active in this field and has been engaged in studying drivers for many years in an attempt to find out their potential accident liabilities.

It will be a great pleasure to hear from him.

STATEMENT OF DR. HAROLD BRANDALEONE, CLINICAL ASSISTANT PROFESSOR OF MEDICINE, NEW YORK UNIVERSITY, COLLEGE OF MEDICINE, CHAIRMAN, COMMITTEE ON STANDARDS FOR MOTOR VEHICLE DRIVERS OF THE INDUSTRIAL MEDICAL ASSOCIATION, NEW YORK, N. Y.

Dr. BRANDALEONE. Mr. Roberts, Dr. McFarland, and members of the committee, I am chairman of the committee on standards for motor vehicle drivers of the Industrial Medical Association, and am appearing today on their behalf.

The medical and psychological factors affecting the driver of a motor vehicle are one of the most important factors in accident prevention.

The medical profession and public must be made cognizant of these facts.

Great effort and money has been expended to cure heart disease and cancer and poliomyelitis, but this effort has been lacking in motor-vehicle accident prevention.

Industry and industrial physicians have been interested in motor-vehicle accident prevention for many years. In 1954, the Industrial Medical Association was one of the first organizations to establish a committee to study motor-vehicle accidents and to create standards for motor-vehicle drivers.

The industrial physician has the responsibility of evaluating the physical qualifications of commercial drivers through preplacement and periodic examinations and thus the unique opportunity to observe the commercial driver over a period of years and to compare his physical and emotional status to his accident record. Our committee is studying the relationship of various organic and mental illnesses to the causation of accidents, to provide factual data, and to create standards for motor-vehicle operators.

The members of our committee have published a manuscript Recommendations for Medical Standards for Motor-Vehicle Drivers, a copy of which accompanies this presentation, and I would like it to be made part of the record together with a copy of a symposium on the medical aspects of motor-vehicle accident prevention that took place at New York University-Bellevue Medical Center. It recommends the type of history and physical examination as well as the frequency that such examinations should be performed. Included is a chart with specific medical conditions that would disqualify civilian, commercial vehicle, and transportation drivers. This chart can be used as a guide and reference for anyone interested in certifying drivers.

The medical factors in motor-vehicle accident prevention consist of organic disease, or physical factors, psychological factors, and drug factors.

As to the physical factors: It is realized that statistical data concerning the role of each medical defect as a potential driving hazard is needed. However, because of the present high mortality and morbidity of motor-vehicle accidents, we must not delay until the results of properly controlled studies are obtained. Based on our knowledge of physiology and clinical medicine, we feel that a medical opinion can be formulated as to the potential danger of various pathological states.

As far as psychological factors are concerned, it is our opinion that psychological testing can be an important tool in the selection of a motor-vehicle operator. It is also our hope that simple, practical, and brief screening tests will be developed for use in industrial and licensing procedures. However, up to the present time, no simple practical group of tests has shown satisfactory results.

A study was made of a group of motor-vehicle operators in industry. Two groups of candidates were selected; one by the usual method and another group selected by the identical method, plus the use of a group of psychological tests which included the Thurstone temperament schedule, Maslow security and insecurity tests, and the standard examination for transit employees recommended by the American Transit Association. The results of these studies indicate that an operator selected by the new method, which included the psychological exam-

inations, had a lower accident frequency than those selected by the older method that did not include the psychological examinations. These results were submitted to statistical evaluation, and were found to be statistically significant.

A trained physician in a brief interview with a candidate for driving may, by experience, determine an emotionally unstable person, even though it usually takes many hours of study to determine the instability of most persons. The interview by a physician should not replace psychological tests, but supplement them.

We realize that the problem of accident prevention is complex. The psychological factors involved in accidents are difficult to determine or prevent. It is known that there are a few persons in every group who are accident prone or accident repeaters, but the majority of persons who are considered to be normal may become emotionally disturbed by temporary external stimuli and become involved in an accident.

Some people suffer acute episodes of stress and as a result, on occasion drive recklessly. I am sure that all of us have gone through the same tense emotional periods when we were late for an important appointment and neglected to adhere to good safety precautions.

A driver angry because of an argument with a member of the family or his supervisor may well become involved in an accident—a manifestation of his aggression.

As to drug factors, alcohol is known to be the most important drug factor in accident prevention. The treatment is simple. Persons drinking alcohol should not drive.

Antihistamines and tranquilizing drugs, which might induce drowsiness, must be prescribed with a great deal of caution to persons who drive motor vehicles. We do not question the value of these drugs, but wish to call to the attention of the attending physicians the possible deleterious effect upon driving ability.

It has been shown that some antihistamines are almost as potent as barbiturates in inducing drowsiness and sleep. As a matter of fact, many proprietary preparations which are sold for the sleep-producing effect are essentially antihistamine proparations. It must be remembered that most proprietary cold medications contain antihistamines.

Drugs for the treatment of hypertension carry a potential danger because of the hypotensive effect as well as the sedative effect.

On the basis of our experience we have made some specific recommendations for research and legislation. I will just mention a few of these: More adequate records; the characteristics of accident-involved drivers as compared to accident-free drivers. Research should be continued to establish the role of depth perception and other visual inadequacies.

It is recommended that a Federal agency be established to coordinate all investigations on motor-vehicle accident prevention and maintain a library.

It is recommended that there be established uniform physical standards for motor-vehicle licensing in all States; to establish periodic physical examination of drivers; to establish more detailed and rigid physical and mental criteria for the interstate commerce standards; to promote education and driver training.

Thank you.

(The documents referred to follow:)

STATEMENT

By

HAROLD BRANDALEONE, M.D., CHAIRMAN

Of the

COMMITTEE ON STANDARDS FOR MOTOR VEHICLE DRIVERS

INDUSTRIAL MEDICAL ASSOCIATION

Before the

SUB-COMMITTEE ON TRAFFIC SAFETY

COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

UNITED STATES HOUSE OF REPRESENTATIVES

SUMMARY

OF

STATEMENT BY HAROLD BRANDALEONE, M.D., CHAIRMAN
COMMITTEE ON STANDARDS FOR MOTOR VEHICLE DRIVERS
INDUSTRIAL MEDICAL ASSOCIATION

1. The Industrial Physician is in an advantageous position to study large numbers of drivers for long periods of time. Therefore, he is able to determine the relationship of physical and mental disease to the cause of motor vehicle accidents.
2. A specific list of physical and mental standards have been presented by Industrial Physicians on the basis of their experience. This list (attachment #1) may act as a guide for physicians and licensing bureaus. The details of the history and physical examination, and the suggested frequency of these examinations have also been presented. The physical, psychological, and drug factors in motor vehicle accident prevention are discussed.
3. There is need for concentrated effort to prevent motor vehicle accidents similar to the effort made to prevent and to treat heart disease, poliomyelitis, and cancer.
4. There is need for funds for research.
5. A central library should be established, where all manuscripts and research reports may be available.
6. Improvement in car safety design should be encouraged.
7. Improvement in driver selection, training, and retraining should be encouraged. Driver education is vital.
8. There is need for strong uniform legislation for driver selection and licensing, and law enforcement.

Mr. Chairman and Members of the Committee:

I am Harold Brandaleone, M.D. of New York City, New York, where I am engaged in the private practice of Medicine, as well as the practice of Industrial Medicine. I am Clinical Assistant Professor of Medicine at New York University College of Medicine. I am Chairman of the Committee on Standards for Motor Vehicle Drivers of the Industrial Medical Association, and I am appearing today on behalf of this Committee.

I would like to express my appreciation for the opportunity to appear before you in order to acquaint you with the work of the Industrial Physician in the study of motor vehicle accidents and their prevention.

Industry and Industrial Physicians have been interested in motor vehicle accident prevention for many years. In 1954, the Industrial Medical Association was one of the first organizations to establish a Committee to study motor vehicle accidents and to create standards for motor vehicle drivers. Members of this Committee were chosen because of their qualifications and experience.

The Industrial Physician has the responsibility of evaluating the physical qualifications of commercial drivers through preplacement and periodic examinations and thus the unique opportunity to observe the commercial driver over a period of years and to compare his physical and emotional status to his accident record. It is the hope of our Committee to study the relationship of various organic and mental illnesses to the causation of accidents, to provide factual data, and to create standards for motor vehicle operators.

We have been cooperating with other agencies such as the American Medical Association Committee on The Medical Aspects of Automobile Injuries and Deaths. We also hope to assist in educating the public, the physician, and Industry concerning the methods of preventing accidents.

The members of our Committee have published a manuscript (1) "Recommendations for Medical Standards for Motor Vehicle Drivers" a copy of which accompanies this presentation. (attachment #1) This publication prescribes the basic physical and mental qualifications for drivers. It recommends the type of history and physical examination, as well as, the frequency that such examinations should be performed. Included is a chart with specific medical conditions that would disqualify civilian, commercial vehicle, and transportation drivers. This chart can be used as a guide and reference for anyone interested in certifying drivers.

At present the Committee is studying the results of a questionnaire sent to Industrial Physicians regarding the relationship of coronary occlusion to motor vehicle accidents.

We are preparing a questionnaire to submit to physicians to learn the statististical relationship of organic disease to motor vehicle accidents. The extent of this survey will depend on the funds available.

You, the members of the Sub-committee on Traffic Safety are aware of the statistics revealing the need for motor vehicle accident prevention. The general public and the Medical profession in particular are not fully aware of the magnitude of this important Public Health problem.

Great effort has understandably been made to prevent and cure Heart Disease, Cancer, and Poliomyelitis, no comparable efforts have been made in accident prevention. Yet, accidents rank first as the cause of death between the ages of one and thirty-five. In 1955, more than one third of all accidental deaths resulted from motor vehicle accidents. (2) This means that a large percentage of accident victims are in the younger age group and implies an enormous total of "life years" lost prematurly. In spite of these facts, serious effort is just beginning in the prevention of motor vehicle accidents. Physicians must realize their importance in the role of motor vehicle accident prevention. They should be oriented in the methods of examination and the problems of selecting drivers. Established medical qualifications of drivers must be made available to physicians.

In 1940, the American Medical Association prepared standards for motor vehicle drivers. (3) Dunlop (4) and Kerr (5) in 1945 reviewed the standards for motor vehicle drivers.

In 1956, Brandaleone and Friedman (6) published a list of physical standards for motor vehicle drivers. In 1956 the American Medical Association appointed a committee on the Medical Aspects of Automobile Crash Injuries and Deaths.

In May 1956, the New York University-Bellevue Medical Center sponsored a Symposium on the Medical Aspects of Motor Vehicle Accident Prevention. It was at this Symposium that a group of Physicians, safety experts, engineers, Licensing Commissioners, Highway Commissioners, members of law enforcement agencies, members of the Legal profession, and the Judiciary, Officials of the Interstate Commerce Commission, Armed Forces, and other Federal agencies interested in motor vehicle accident prevention were brought together to study this problem. Their findings were published (10) and are attached to this report. (attachment #2)

The three major factors in motor vehicle accident prevention are: the road, the vehicle, and the driver. Great strides have been made in the improvement of the road or the highway, and the motor vehicle. However, the human element, the major factor in the cause of accidents, has been neglected. One out of every fourteen drivers involved in fatal accidents had a physical condition that could have been a contributing factor to the accident. (2)

Previous communications have demonstrated the results in industry of comprehensive medical programs on the reduction of motor vehicle accidents. (7)

Drivers may be classified into two general types: civilian or private drivers and commercial or industrial drivers who drive for a living. The latter includes drivers of trucks and drivers of transportation

vehicles. The transportation driver should be under the most rigid regulations. The commercial vehicle driver should be supervised more carefully than the non-industrial driver.

On the basis of our experience, we recommend that every applicant for a commercial motor vehicle operators license should have a complete medical examination, as well as, periodic examinations, depending on his age, and the type of work performed. Records should be maintained on all drivers concerning their illness and disabilities in order to determine whether they are suitable for driving.

THE TYPE AND FREQUENCY OF EXAMINATION:

(Attachment #1)

TYPE:

History and physical examination records may be altered to suit individual requirements, but the minimum should be as follows: (1) The private or civilian operator should have a medical examination that includes a history and physical. A urine analysis should be performed. The physician's examination and opinion should be sent to the Motor Vehicle Bureau. The Motor Vehicle Bureau should be responsible for accepting or rejecting a candidate.
(2) Commercial or transportion vehicle operators should be examined by qualified physicians who should certify as to the ability of a candidate to perform the job. However, before a candidate is seen by the physician, he should be interviewed in the Personnel Department of the industrial organization and the following data obtained: (1) Age, (2) Marital status, (3) Education, (4) Occupation, (5) Number of positions held during the previous five years, (6) Reasons for termination of previous employment, and (7) Annual salary. In addition to information concerning financial savings or indebtedness, previous accident records, arrests and court records should be obtained. Under the direction of the examining physician vision tests using modern techniques with binocular instruments should be performed. Color blindness may be examined, but should not be a factor in determining the candidate's ability to drive except under special type of driving. In addition, the candidate should be given a group of psychological tests which will be discussed in detail later. Chest x-rays, electrocardiogram and serology should also be performed. The results of these examinations should be classified according to a profile system. (8) The acceptability of the candidate for the job should be made on the basis of recommended medical standards. (1, 6, 8)

It is recommended that civilian drivers up to the age of 45 years should be examined every three years, and after 45, every 2 years. Industrial and transportation drivers should have a preplacement examination and periodic physical examination every two years up to the age of 45 and annually thereafter.

Briefly, any candidate should be rejected if he presents a disability that could suddenly incapacitate him and be the direct cause of an accident. However, candidates should also be disqualified for

conditions that may be indirectly incapacitating. For example, severe hemorrhoids may cause a bus operator so much discomfort, that his attention may be diverted and cause him to be involved in an accident. A candidate for the job of driving a commercial vehicle or truck who has tuberculosis or a severe low back syndrome should not be qualified for the job if he is required to do heavy lifting. In industry a thorough knowledge of job requirements is necessary in order to evaluate the candidate properly. When the candidate is finally accepted, he should be put through a rigid training program with instructions on how to drive and avoid accidents and should be brought back for retraining and medical examinations at periodic intervals.

MEDICAL FACTORS

The medical factors in motor vehicle accident prevention consist of organic disease, or physical factors, psychological factors, and drug factors.

PHYSICAL FACTORS:

It is realized that statistical data concerning the role of each medical defect as a potential driving hazard is needed. However, because of the present high mortality and morbidity of motor vehicle accidents, we must not delay until the results of properly controlled studies are obtained. Based on our knowledge of physiology and clinical medicine, we feel that a medical opinion can be formulated as to the potential danger of various pathological states.

For example, a diabetic on insulin who has insulin reactions or a patient with uncontrolled convulsive seizures should not be permitted to drive. Certain neurological conditions that might be incapaciting should be disqualifying. Certain heart conditions (such as aortic stenosis, congestive heart failure, carotid sinus syndrome, Adams Stokes syndrome, or any other cardiac condition) that might suddenly incapacitate the driver, should be disqualifying. Our recommendations are presented in detail in chart 4 of attachment #1.

We advise that preplacement or pre-licensing examinations, and periodic examinations be performed as recommended. We also recommend that present criteriae be utilized with modifications to suit the individual needs until more studies have been published.

PSYCHOLOGICAL FACTORS:

Based on our experience in industry, it is our opinion that psychological testing can be an important tool in the selection of a motor vehicle operator. It is also our hope that simple, practical and brief screening tests will be developed for use in industrial and licensing procedures. However, up to the present time, no simple practical group of tests has shown satisfactory results.

A study was made of a group of motor vehicle operators in industry. (9) Two groups of candidates were selected: one by the usual method and another group selected by the identical method, plus the

use of a group of psychological tests which included the Thurstone Temperament schedule, Maslow Security and Insecurity tests and the standard examination for transit employees recommended by the American Transit Association. The results of these studies indicate that an operator selected by the new method, which included the psychological examinations, had a lower accident frequency than those selected by the older method that did not include the psychological examinations. These results were submitted to statistical evaluation, and were found to be statistically significant.

A trained physician in a brief interview with a candidate for driving may, by experience, determine an emotionally unstable person, even though it usually takes many hours of study to determine the instability of most persons. The interview by a physician should not replace psychological tests, but supplement them.

We realize that the problem of accident prevention is complex. The psychological factors involved in accidents are difficult to determine or prevent. It is known that there are a few persons in every group who are accident-prone or accident repeaters, but the majority of persons who are considered to be normal may become emotionally disturbed by temporary external stimuli and become involved in an accident.

Some people suffer acute episodes of stress and as a result, on occasion drive recklessly. I am sure that all of us have gone through the same tense emotional periods when we were late for an important appointment and neglected to adhere to good safety precautions.

A driver angry because of an argument with a member of the family or his supervisor may well become involved in an accident—a manifestation of his aggression.

The following case demonstrates the effect of emotional instability. A 28-year-old white male, driver was severely disturbed over his five-year-old mentally retarded child who was a patient in a state hospital. The doctors had just informed him that the prognosis was extremely poor. He came to the physician for advice and was found to be so depressed that he was advised to discontinue driving. The only position that was available at the time was that of a driver in a garage. In an effort to assist him and not increase his difficulties, he was permitted to accept this job. He continued to be disturbed about his child, and one day while driving in a garage he pinned another person against a vehicle, and killed him.

DRUG FACTORS:

Alcohol is known to be the most important drug factor in accident prevention. The treatment is simple. Persons drinking alcohol should not drive.

Antihistamines and tranquilizing drugs, which might induce drowsiness, must be prescribed with a great deal of caution to persons who drive motor vehicles. We do not question the value of these drugs, but wish to call to the attention of the attending physicians the possible

deleterious effect upon driving ability. It has been shown that some antihistamines are almost as potent as barbiturates in inducing drowsiness and sleep. As a matter of fact many proprietary preparations which are sold for the sleep producing effect are essentially antihistamine preparations. It must be remembered that most proprietary cold medications contain antihistamines.

Drugs for the treatment of hypertension carry a potential danger because of the:

1. The hypotensive effect, as well as,
2. The sedative effect.

Amphetamine and the other stimulating drugs are dangerous only because the driver depends on the medication to overcome overwhelming fatigue which they will not do, so the driver frequently remains or soon becomes drowsy again.

The Interstate Commerce Commission records reveal a case of a driver who had been using Amphetamine for enforced stimulation. He had fallen asleep at the wheel, driven his large trailer truck off the road into a river bed and had been killed. A letter addressed to his brother found on the driver's body at the time of the investigation into his death, stated that he had been driving continuously for three days without sleep using Benzedrine to stay awake. Like so many others, this driver expected Benzedrine to do more than it is capable of doing.

The need for research is essential! Confirmation of the relationship between certain physical conditions and accident causation is desirable. These studies must be performed under strict medical control. The following are recommendations for suggested research. Some of these studies are all ready in progress.

1. More adequate accident records need to be devised and put into use to provide significant information for research purposes.
2. The characteristics of accident-involved drivers need to be more carefully compared with those of accident-free drivers.
3. Psychiatric-psychologic research centers should be set up to develop practical techniques that would assist licensing authorities in the assessment of the mental and emotional fitness of driver license applicants.
4. There is a need for comprehensive data, on the effects of organic disease and the aging process on the motor vehicle accident rate.
5. Studies should be made to determine specific organic disabilities that limit the ability of individuals to drive safely.
6. The traffic safety records of cardiac patients should be compared with those of non-cardiac individuals and evaluation made of all data related to specific cardiac defects.
7. Research should be continued to establish the role of depth perception, muscle balance, and visual and perceptual reaction time in the causation of motor vehicle accidents.

8. A study should be made, possibly by the Veterans Administration, of the driving record of veterans who are amputees or have other orthopedic disabilities and operate automobiles with special equipment. Collection of data should be facilitated if state licensing authorities maintained separate files for all drivers using special controls on motor vehicles.

9. Studies are needed to relate objective measures of drivers performance to levels of alcohol in the body, comparisons to be made of individuals involved in accidents, individuals apprehended for traffic violations only, and a third or control group of drivers involved in neither accidents or violations.

10. A comparative study should be made of the driving performance of individuals who drink alcohol and those who do not.

11. Chemical and pharmacologic research is needed to determine whether metabolic products other than alcohol impair the driving ability of individuals who have consumed alcohol.

12. Federal, State, and private agencies should combine forces to support research on the pharmacologic effects of commonly used drugs, including stimulants, sedatives, antihistamines, antihypertensives, and tranquilizers, as they relate to or influence driving behavior.

It is recommended that Legislation be enacted as follows:

1. For a Federal agency to coordinate all investigations on motor vehicle accidents, and to maintain a library on all motor vehicle accident prevention data.

2. To provide funds for proper investigations and study of motor vehicle accident prevention.

3. To establish uniform physical standards for motor vehicle licenses in all states.

4. To establish periodic physical examinations of all drivers.

5. To establish more detailed and rigid physical and mental criteriae for I.C.C. standards.

6. Each state motor vehicle bureau should have a medical advisory board to advise on medical problems.

7. To establish temporary licenses for some sick individuals on the basis of impartial specialist's examination. The cost of this examination to be paid by the applicant.

8. Promote proper educational plans in an effort to increase the education of the public, physicians, and industry.

9. A driver training program be established for high school students and new adult drivers as a prerequisite for licensing.

10. A driver retraining course be taken at periodic intervals after attaining a license.

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Recommendations for Medical Standards for Motor Vehicle Drivers

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THE INCREASING number of fatalities and serious injuries due to motor vehicle accidents makes prevention of these accidents an important problem in public health.[1] It is imperative to inform the medical profession of its role in accident prevention. Physicians need to realize that good health is essential to safe driving. They must be able to advise patients when their medical conditions militate against driving.

Standards for physical fitness of drivers were prepared by the American Medical Association in 1940;[2] reviews of the Medical Standards for Drivers were given by Dunlop[3] and Kerr[4] in 1945.

In 1950, a study of the health of bus operators in the Third Avenue Transit System in New York City was begun. It was found that there was a correlation between the physical and mental health of the operators and accident prevention.

CHART I

PRIVATE OR CIVILIAN DRIVERS HEALTH HISTORY

_____ 19____

NAME _____

DATE OF BIRTH____ AGE____ SEX____ M.S.W.D.___

PERSONAL PHYSICIAN _____

ADDRESS _____ TELEPHONE_____

Ulcers of stomach _____ Gonorrhea _____

Stomach trouble _____ Anemia _____

If "Yes," What?_____

7. How much beer do you drink each day?____.

How much whiskey?_____

DATE OF BIRTH_____AGE_____SEX_____M.S.W.D._____

PERSONAL PHYSICIAN _____

7. How much beer do you drink each day?_____

ADDRESS _____ TELEPHONE_____

ANSWER "YES" OR "NO" to the following questions:
DO NOT USE CHECK MARKS

1. Have you ever been rejected by any life insurance company?_____If so, Why?_____
2. Have you ever been a patient in any hospital, institution or asylum?_____ If "Yes," when, where, and what for? _____
3. Were you in World War I, II, or Korea?_____
4. Were you rejected for military service?_____ If "Yes," Why?_____
4A. What type of military discharge_____ Regular_____ Medical_____ Other_____ If other than Regular, give reasons_____
5. Have you ever received disability compensation from the government, any corporation or individual? _____
6. Have you ever been treated for, do you have, or have you ever had any of the following? ANSWER "YES" or "NO"

Head injuries _____	Hemorrhoids (piles) _____
Mental or nervous disease or disorder ___	Missing fingers or toes ___ Liver disease _____
Tuberculosis _____	Jaundice _____
Pneumonia _____	Dysentery ("runs") _____
Asthma _____	Hives _____
Bronchitis _____	Any allergy _____
Surgical operations _____	High blood pressure _____
Heart disease _____	Diabetes _____
Rheumatism _____	Nervous breakdown _____
Arthritis _____	Syphilis _____

How much whiskey?_____

7A. Do you take any drugs or medicine?_____ If "Yes," What?_____
8. Do you have any deformities or disabilities_____ If "Yes," What? _____
9. Have you any of the following symptoms:

Nervousness _____	Fast heart rate _____
Headache _____	Pain around heart _____
Dizziness _____	Cough _____
Fainting spells _____	Chest pain _____
Convulsions (fits) _____	Do you wear glasses ____
Do you cry easily _____	Blurred vision _____
Quick temper _____	Double vision _____
Irritable _____	Ringing in ears _____
Weakness _____	Ear trouble _____
Trembling hands _____	Choking sensation _____
Tiredness _____	

10. Do you have any menstrual pain or irregularities? _____
11. Have you any physical defect whatever, which might under strain, or in the performance of duties requiring physical alertness and muscular activity, result in disablement or otherwise incapacitate you? If "Yes," What?_____
12. Have you been ill during the past three years? If "Yes," Give details_____
13. How many days were lost from work during the past year?_____

DATE_____

_____
APPLICANT

Through a comprehensive medical program and improved driver selection, accidents were reduced more than 50% in this company.[5,6]

In January, 1956, Brandaleone and Friedman published a list of Physical Standards for Vehicle Operators.[7]

Since the human element is a major factor in accident prevention, the following recommendations are suggested for the frequency and type of medical examinations to be made. It is expected that these recommendations may be changed as necessary by industrial physicians, licensing bureaus, or others using these criteria as a standard for motor vehicle drivers. It is hoped that standard rules and regulations will be established by all licensing bureaus in the country just as the Interstate Commerce Commission established minimal standards for drivers under its jurisdiction.

Frequency of Examination

1. CIVILIAN DRIVERS up to the age of 45 years should be examined every three years, and after 45, every two years.

2. INDUSTRIAL AND TRANSPORTATION DRIVERS should have a pre-placement examination and a periodic physical examination every two years up to the age of 45, and annually thereafter.

It is further recommended that every driver in industry absent from work for more than 28

CHART 2

COMMERCIAL OR INDUSTRIAL DRIVERS HEALTH HISTORY

_____ 19_____

NAME _____

DATE OF BIRTH_____ AGE_____ SEX_____ M.S.W.D.___

PERSONAL PHYSICIAN _____ TELEPHONE_____

ADDRESS _____ POSITION_____

ANSWER "YES" or "No" to the following questions:

1. Have you ever been rejected by any life insurance company? _____
   If "Yes," Why? _____
2. Have you ever been a patient in any hospital, institution or asylum?_____
   If "Yes," when, where and what for? _____
3. Were you in World War I, II, or Korea?

Back trouble or injury _____

Surgical operations_____ if "Yes," What?_____

Missing fingers or toes _____

Fractures, broken bones, or sprains_____

7. How much beer do you drink each day?_____
   How much whiskey? _____
7A. Do you take any drugs or medicines? "Yes" or "No"_____ If "Yes," What?_____
8. Do you have any deformities or disabilities?___
   If "Yes," What?_____
9. Do you have any of the following symptoms:

Nervousness _____ Joint pains _____

Headache _____ Fast heart beat _____

Dizziness _____

institution or asylum? _____
If "Yes," when, where and what for? _____

Headache _____ Fast heart beat _____

3. Were you in World War I, II, or Korea? _____
4. Were you rejected for military service _____
   If "Yes," Why? _____
4A. What type of military discharge _____
   REGULAR _____ MEDICAL _____ OTHER _____
5. Have you ever received disability compensation, from the government, any corporation or individual _____
6. Have you ever been treated for, do you have or have you ever had any of the following:
   ANSWER "YES," or "NO"

Head injuries		Hemorrhoids (piles)	
Mental or nervous disease or disorder		Arthritis	
		Ulcers of stomach	
Tuberculosis		"Stomach trouble"	
Pleurisy		Gallbladder disease	
Pneumonia		Liver disease	
Asthma		Jaundice	
Bronchitis		Dysentery	
Influenza		"Kidney trouble"	
Heart disease		"Bladder trouble"	
Rheumatism		"Prostate trouble"	
Hernia (rupture)		Accidents	
Malaria		Varicose veins	
Typhoid fever		Skin rashes	
Scarlet fever		Boils	
Diphtheria		Sinus trouble	
Hay fever		Frequent colds	
Hives		Sore throats	
Any allergy		Anemia	
Nervous breakdown		Blood disease	
Diabetes		Syphilis	
High blood pressure		Gonorrhea	

Dizziness		Shortness of breath	
Fainting spells		Swelling of feet	
Convulsions (fits)		Pain around heart	
Excess sweating		Cough	
Do you cry easily		Chills	
Quick temper		Fever	
Hands tremble		Chest pain	
Weakness		Spitting of blood	
Tiredness		Nausea, vomiting	
Muscle pains		Bleeding	
	(Lost	Getting up at night	
Have	(Gained weight	to pass urine	
you	(recently	Wear glasses	
	(How much	Blurred vision	
	(In how long	See double	
"Nervous stomach		Ringing in ears	
"Stomach pains		Ear trouble	
Diarrhea ("runs")		Skin disease rash	
Constipation		Choking sensation	
"Heartburn"		Hoarseness	
Frequent urination		Sore throat	
Burning on urination			

10. Have you any physical defect whatever, which might under strain, or in the performance of duties requiring physical alertness and muscular activities, result in disablement or otherwise incapacitate you? _____
11. Have you been ill during the past three years? if "Yes," give details _____
12. How many days were lost from work during the past year _____

_____
Applicant

days because of illness or an accident be examined before returning to work, to be sure that he is not a hazard to himself or to the public.

Type of Examination

CHARTS 1, 2 and 3 are recommended as sample history and physical examination records. These forms may be altered to suit individual requirements.

1. PRIVATE OR CIVILIAN OPERATORS: Examination should include the history and physical as noted in Charts 1 and 3. A urinalysis should be performed. A copy of the medical record should be sent to the State Motor Vehicle Bureau for detailed examination. The Motor Vehicle Bureau should accept or reject a candidate for a driver's license.

2. COMMERCIAL VEHICLE AND TRANSPORTATION OPERATORS: Examination should be performed by a qualified physician, who should certify to the ability of the candidate to perform his job. The examination should include:

A history and physical examination as noted in Charts 2 and 3.

Psychological testing.

Visual tests (including Snellen, telebinocular, or Ortho-Rater, color blindness, peripheral vision, depth perception, and glare resistance).

Urine examination.

Chest x-ray.

Serology.

The recommendations shown in Chart 4 are submitted as nonacceptable conditions for driving. Since the list of *acceptable* medical standards is too lengthy to publish in this report, we are presenting only those conditions which disqualify the operator in each category.

WE WISH to emphasize that this list is presented as a *temporary guide*, to be changed as more data are accumulated, and to serve industry and licensing bureaus as their needs require.

CHART 3

PHYSICAL EXAMINATION MOTOR VEHICLE DRIVERS

PREPLACEMENT ☐
PERIODIC ☐

_____ 19____

NAME _____ ADDRESS _____
AGE____ RACE____ M.S.W.D.____ SEX____
NEXT OF KIN_____ POSITION APPLIED FOR_____

Glare recovery _____ Normal_____
Subnormal_____
Ears____ Hearing_____ R_____ L_____
Teeth_____ Gums_____
Nose_____ Throat_____ Tongue_____
Neck_____ Thyroid_____

Obstetrical and menstrual history

AGE_____ RACE_____ M.S.W.D._____

NEXT OF KIN_____ POSITION APPLIED FOR_____

Nose_____ Throat_____

Neck_____ Thyroid_____

Obstetrical and menstrual history _____

Personality data:-

Appearance	(Neat	_____
	(Careless	_____
	(Slovenly	_____
Intelligence	(Quick	_____
	(Average	_____
	(Dull	_____
Temperament	(Aggressive	_____
	(Quiet	_____
	(Cooperative	_____
	(Non-cooperative	_____
Schooling	(Advanced	_____
	(Average	_____
	(Retarded	_____

Height_____ Weight_____ Wear glasses_____

Musculature_____ Temp._____ Pulse_____

Posture_____ Nutrition_____ Skin_____

Glands_____ Hair_____ Scalp_____

Head_____ Skull_____

Eyes:

Color sense _____

Eye grounds _____

Vision without glasses___ Vision with glasses___

R R

L L

B B

Horizontal field of vision_____ Normal_____

Subnormal_____

Depth perception _____ Normal_____

Subnormal_____

Chest: Thorax

Breasts

Lungs _____

Heart P.M.I._____ I C S M C L B P

Rhythm_____ Rate_____ Murmurs_____

Sounds _____

Abdomen_____ Genitals_____

Hernia (wears truss?) _____

Back-Pelvis-Spine _____

Extremities-Upper_____ Lower_____ Flat Feet_____

Rectum_____ Prostate_____

Reflexes-Nervous system _____

Scars-Deformities-Disabilities _____

Laboratory:

Urine_____ Serology_____

C.B.C._____ X-ray of chest_____

Emotional and psychiatric evaluation_____

Diagnos's and recommendations_____

Military medical records_____

PROFILE

DATE	PHYSICAL CAPACITY		ORGANIC DEFECTS	
EYES	EARS	NEURO PSYCHIATRIC	MOTORABILITY	

This is to certify that I have examined_____ on_____ and found him {Qualified_____ Unqualified_____ To drive a_____ vehicle. I have retained a copy of the findings.

_____

EXAMINING PHYSICIAN

CHART 4

A Reference List of Conditions Which May be Non-acceptable for Driving

GENERAL STATEMENT

It is hoped that these criteria will serve as a guide in determining the qualifications of motor vehicle operators.

Veteran operators with years of driving experience should receive special consideration if their medical defects will not lead to sudden incapacity which might endanger public safety.

Any condition that might suddenly incapacitate a person, so that he might be unable to control his senses or his ability to drive a vehicle, is considered disqualifying.

Under general defects there are several medical problems which should disqualify a motor vehicle operator:

(1) USE OF DRUGS:

(a) Narcotics. (b) Sedatives in excess. (c) Antihistamines in excess. (d) Stimulants — excessive or chronic use of benzedrine or dexedrine. (e) Drug sensitivity.

(2) ALCOHOL: Chronic or excessive use.

There are some instances where temporary disqualifications occur, e.g., acute febrile illness, plaster cast, postoperative state. When the acute state is over, the applicant may be reclassified.

It is understood that these criteria are rigid and may require some change in individual circumstances.

TRANSPORTATION OPERATORS	COMMERCIAL VEHICLE OPERATORS	CIVILIAN OPERATORS
HEIGHT AND WEIGHT		
Those outside 20% of acceptable life insurance figures for normal height, weight and age, if sufficient to interfere with driving.	Those outside 20% of acceptable life insurance figures for normal height, weight and age, if sufficient to interfere with driving.	No limits.
SKIN		
Any chronic skin disease which renders the operator unfit for bus operation or so disfiguring as to render the individual objectionable to passengers. Pilonidal cyst. Extensive scars which interfere with function. Cysts or benign tumors of such a size and/or location as to interfere with driving. Exfoliative dermatitis. Pemphigus. Plantar warts, if severe.	Any chronic skin disease which renders the operator unfit for driving. Pilonidal cyst. Extensive scars which interfere with function. Cysts or benign tumors of such a size and/or location as to interfere with driving. Exfoliative dermatitis. Pemphigus. Plantar warts, if severe.	Any chronic skin disease which renders the operator unfit for driving. Extensive scars which interfere with function. Cysts or benign tumors of such a size and/or location as to interfere with driving.
HEAD		
Deformities of the skull which are symptomatic or associated with underlying disease of the brain, spinal cord or peripheral nerves.	Deformities of the skull which are symptomatic or associated with underlying disease of the brain, spinal cord or peripheral nerves.	Deformities of the skull which are symptomatic or associated with underlying disease of the brain, spinal cord or peripheral nerves.
FACE AND NECK		
Facial neuralgia, severe.	Facial neuralgia, severe.	

pheral nerves.	pheral nerves.	pheral nerves.
FACE AND NECK		
Facial neuralgia, severe.	Facial neuralgia, severe.	Facial neuralgia, severe.
Torticollis, or spastic contraction of the neck muscle, if severe.	Torticollis, or spastic contraction of the neck muscle, if severe.	Torticollis, or spastic contraction of the neck muscle, if severe.
EYES		
Monocular vision.	Monocular vision.	Monocular vision with less than 20/40 in the other eye.
Visual acuity less than 20/40 in each eye corrected.	Visual acuity less than 20/40 in each eye corrected.	Visual acuity in each eye less than 20/200 correctible to 20/40.
Any severe, active, chronic or progressive disease of the eye.	Any severe, active, chronic or progressive disease of the eye.	Any severe active, chronic or progressive disease of the eye.
Marked muscle imbalance and/or astigmatism.	Marked muscle imbalance and/or astigmatism.	Marked muscle imbalance and/or astigmatism.
Marked nystagmus.	Marked nystagmus.	Marked nystagmus.
Diplopia.	Diplopia.	Diplopia.
Marked impairment of depth perception, glare resistance and defect in visual fields.	Marked impairment of depth perception, glare resistance and defect in visual fields.	Marked impairment of depth perception, glare resistance and defect in visual fields.
EARS		
Auditory acuity less than normal spoken voice audible each ear at 2 feet.	Auditory acuity less than normal spoken voice audible each ear at 2 feet.	Less than normal spoken voice audible in one ear at 2 feet.
Audiometric above 50 decibel loss at a frequency of 2000 cycles per second.	Audiometric above 50 decibel loss at a frequency of 2000 cycles per second.	Vestibular disturbance (vertigo).
Vestibular disturbance (vertigo).	Vestibular disturbance (vertigo).	
NOSE AND THROAT		
Irremediable deformities of mouth, nose and throat which interfere with feeding, speech or breathing.		
Hay fever, if severe.	No restrictions.	No restrictions.
Nasal obstruction, caused by deviated septum or hypertrophic rhinitis or other causes if sufficient to produce mouth breathing.		
Laryngeal paralysis; aphonia.		
MOUTH		
Serious disease of the jaw.	No restrictions.	No restrictions.
THORACIC CAGE		
Unhealed sinuses of the chest.		
Deformities or scars which decrease cardiac or respiratory function sufficiently to interfere with driving.	Deformities or scars which decrease cardiac or respiratory function sufficiently to interfere with driving.	Deformities or scars which decrease cardiac or respiratory function sufficiently to interfere with driving.
Osteomyelitis or necrosis or chronic infection of bones of chest cage.		

CHART 4 — Continued

TRANSPORTATION OPERATORS	COMMERCIAL VEHICLE OPERATORS	CIVILIAN OPERATORS
LUNGS		
Foreign body in the lung, or mediastinum causing symptoms or active inflammatory reaction.	Foreign body in the lung, or mediastinum causing symptoms or active inflammatory reaction.	Any respiratory disease which is disabling.
Old pleura thickening, i.e., secondary to hemothorax with impairment of respiratory function.	Old pleura thickening, i.e., secondary to hemothorax with impairment of respiratory function.	
Chronic bronchitis more than mild, or, if mild, unresponsive to therapy.	History or evidence of active tuberculosis.	
History or evidence of active tuberculosis.	Tumors of the trachea, bronchi, lungs, pleura or mediastinum.	
Acute or chronic lung abscess.	Bronchial asthma, severe.	
Mycotic condition of the lung.	Pulmonary fibrosis, severe.	
Tumors of the trachea, bronchi, lungs, pleura or mediastinum.	Pulmonary emphysema, severe.	
Bronchial asthma.		
Bronchiectasis.		
Pulmonary fibrosis, severe.		
Pulmonary emphysema, severe.		
HEART AND VASCULAR SYSTEM		
History of rheumatic fever, hypertension, cardiovascular syphilis to be evaluated.	History of rheumatic fever, hypertension, cardiovascular syphilis to be evaluated.	Severe diminished cardiac reserve.
History of diminished cardiac reserve.	History of diminished cardiac reserve.	Congenital heart disease except for minor defects.
Congenital heart disease except for minor defects.	Congenital heart disease except for minor defects.	Aortic stenosis or combined valvular disease.
Hypertrophy and dilation of the heart observed clinically and confirmed by fluoroscopy and x-ray examination.	Aortic stenosis or combined valvular disease.	Coronary artery disease with anginal syndrome (to be evaluated).
All organic valvular diseases.	Coronary artery disease with anginal syndrome, or myocardial infarction due to any cause.	Aneurysm of any centrally located or major vessel.
Coronary artery disease with anginal syndrome or myocardial infarction due to any cause.	Aneurysm of any vessel.	Heart block of significant degree (a slight increase in P-R intervals in the absence of other evidence of heart disease need not disqualify).
Pericarditis; myocarditis; endocarditis.	Severe paroxysmal tachycardia within the preceding five years.	Hypertension above 180/100.
Myocardial fibrosis or scarring.	Heart block of significant degree (a slight increase in P-R intervals in the absence of other evidence of heart disease need not disqualify).	Any serious disturbance of rhythm, e.g., auricular fibrillation or flutter.
Aneurysm of any vessel.	Hypertension above 180/100.	Orthostatic hypotension if marked and persistent.
Persistent heart rate of 100 or more unless in the opinion of the medical examiner the increased rate is due to psychic reaction and is not secondary to any disease condition such as in-	Any serious disturbance of rhythm, e.g. auricular fibrillation or flutter.	Carotid sinus hyper-reactivity.
		Cerebrovascular disease with or without

psychic reaction and is not secondary to any disease condition such as infection.	Any serious disturbance of rhythm, e.g. auricular fibrillation or flutter.	Cerebrovascular disease with or without paralysis.
Severe paroxysmal tachycardia within the preceding five years.		
Heart block of significant degree (a slight increase in P-R intervals in the absence of other evidence of heart disease need not disqualify).		
Hypertension evidenced by persistent reading above 150/90.		
Any serious disturbance of rhythm, e.g., auricular fibrillation or flutter.		
Neurocirculatory asthenia.		
Abnormalities of the peripheral vascular system (e.g., Raynaud's, Buerger's disease, erythromelalgia, arteriosclerosis of leg vessels).		
Varicose veins if severe or if associated with edema or skin ulcers.		
Thrombophlebitis or chronic venous insufficiency resulting from thrombophlebitis if there is any persistence or thrombus or evidence of circulatory obstruction; recurrent thrombophlebitis.	Thrombophlebitis or chronic venous insufficiency resulting from thrombophlebitis if there is a persistence of the thrombus or evidence of circulatory obstruction; recurrent thrombophlebitis.	
Orthostatic hypotension if marked and persistent.	Orthostatic hypotension if marked and persistent.	
Carotid sinus hyper-reactivity.	Carotid sinus hyper-reactivity.	
Cerebral vascular disease with or without paralysis.	Cerebrovascular disease—with or without paralysis.	
ABDOMEN AND VISCERA		
Wounds, injuries, scars or weakness of muscles of abdominal walls, sufficient to interfere with function.	Wounds, injuries, scars or weakness of muscles of abdominal walls, sufficient to interfere with function.	History of severe gastrointestinal tract bleeding.
Chronic disease of the liver, spleen or pancreas.	Chronic disease of the liver, spleen or pancreas.	
Chronic disease of stomach or intestines, (diverticulitis, ileitis, or colitis).	Chronic disease of stomach or intestines, (diverticulitis, ileitis, or colitis).	
Peptic ulcer or ulcer syndrome.	Peptic ulcer or ulcer syndrome.	
Chronic cholecystitis with or without cholelithiasis.	Chronic cholecystitis with or without cholelithiasis.	
External or internal hemorrhoids until corrected if severe.	External or internal hemorrhoids until corrected if severe.	
Proctitis or prolapse of rectum.	Proctitis or prolapse of rectum.	
Fistula in ano; ischiorectal abscess.	Fistula in ano; ischiorectal abscess.	
History of melena or hematemesis.	History of melena or hematemesis.	

CHART 4 — Continued

TRANSPORTATION OPERATORS	COMMERCIAL VEHICLE OPERATORS	CIVILIAN OPERATORS
ABDOMEN AND VISCERA—Continued		
Intestinal parasites unless remedied.	Intestinal parasites unless remedied.	
History of splenectomy or other than trauma or congenital hemolytic jaundice.	History of splenectomy or other than trauma or congenital hemolytic jaundice.	
Syphilis or tuberculosis of the viscera.	Syphilis or tuberculosis of the viscera.	
Neoplasm of the viscera.	Neoplasm of the viscera.	
Inguinal, femoral or symptomatic ventral hernia.	Inguinal, femoral or symptomatic ventral hernia.	
GENITOURINARY		
Symptomatic disease of genitourinary tract, i.e., renal calculi, cystitis, severe, prostatis, uremia.	Symptomatic disease of genitourinary tract, i.e., renal calculi, cystitis, severe, prostatis, uremia.	Uremia.
VENEREAL DISEASE		
Cardiovascular and central nervous system—syphilis.	Cardiovascular and central nervous system—syphilis.	Cardiovascular and central nervous system—syphilis.
SPINE AND OTHER MUSCULOSKELETAL		
Any disease of bone, muscle or joint which interferes with function.	Any disease of bone, muscle or joint which interferes with function.	Any disease of bone, muscle or joint which interferes with function.
Any symptomatic disease of bone or muscle, or joint.	Any symptomatic disease of bone or muscle, or joint.	
EXTREMITIES		
Any abnormality, deformity or disease which interferes with function.	Any abnormality, deformity or disease which interferes with function.	Any abnormality, deformity or disease which interferes with function.
Muscular paralysis, contraction or atrophy if progressive, or of sufficient degree to interfere with function.	Muscular paralysis, contraction or atrophy if progressive, or of sufficient degree to interfere with function.	
Scars, extensive, deep or adherent of such a degree as to interfere with function.	Scars, extensive, deep or adherent of such a degree as to interfere with function.	
Chronic symptomatic or progressive disease of any joint.	Chronic symptomatic or progressive disease of any joint.	
Club foot, if severe.	Club foot, if severe.	
Active osteomyelitis or history of same, except when treated successfully two or more years previously without subsequent recurrent or disqualifying sequelae.	Active osteomyelitis or history of same, except when treated successfully two or more years previously without subsequent recurrent or disqualifying sequelae.	

quelae.	quelae.	
Symptomatic osteoarthritis, rheumatoid arthritis.	Symptomatic osteoarthritis, rheumatoid arthritis.	
Plantar warts, if severe.	Plantar warts, if severe.	
ENDOCRINE AND METABOLIC		
Thyrotoxicosis.	Thyrotoxicosis.	Thyrotoxicosis.
Thyroid enlargement with pressure symptoms.	Thyroid enlargement with pressure symptoms.	Myxedema or cretenism.
Myxedema or cretenism.	Myxedema or cretenism.	Diabetes mellitus uncontrolled with insulin.
Gigantism or acromegaly.	Hyperparathyroidism and hypoparathyroidism.	Hyperinsulinism.
Frohlich's syndrome, if severe.	Diabetes mellitus if requiring the use of insulin.	
Hyperparathyroidism and hypoparathyroidism.	Diabetes insipidus.	
Diabetes mellitus if requiring the use of insulin.	Simmond's disease, Cushing's syndrome, Addison's disease, or other disease of pituitary adrenal axis.	
Diabetes insipidus.	Hyperinsulinism.	
Simmond's disease, Cushing's syndrome, Addison's disease, or other disease of pituitary adrenal axis.		
Hyperinsulinism.		
BLOOD AND BLOOD-FORMING ORGANS		
Any severe anemia (pernicious anemia, aplastic anemia, splenic anemia, sickle-cell anemia).	Any condition which might lead to sudden bleeding and syncope.	Any condition which might lead to sudden bleeding and syncope.
Thrombocytopenic or other non-traumatic purpura.		
Polycythemia vera.		
Leukemia.		
Hodgkin's disease.		
Lymphosarcoma.		
Hemophilia, or any bleeding tendency.		
PSYCHIATRIC DISORDERS		
Psychosis.	Psychosis.	Psychosis.
Moderate severe chronic psychoneurosis.	Moderate severe chronic psychoneurosis.	Moderate severe chronic psychoneurosis.
Severe transient psychoneurosis (situational).	Severe transient psychoneurosis (situational).	Severe transient psychoneurosis (situational).
Marked degree of character, behavior or personality disorder which has prevented good adjustment with particular reference to any antisocial tendencies, overt homosexuality, chronic alcoholism, or drug addiction.	Marked degree of character, behavior or personality disorder which has prevented good adjustment with particular reference to any antisocial tendencies, overt homosexuality, chronic alcoholism, or drug addiction.	Marked degree of character, behavior or personality disorder which has prevented good adjustment with particular reference to any antisocial tendencies, overt homosexuality, chronic alcoholism, or drug addiction.
Marked mental deficiency.	Marked mental deficiency.	Marked mental deficiency.
Perversion.	Perversion.	Perversion.

CHART 4 — Continued

TRANSPORTATION OPERATORS	COMMERCIAL VEHICLE OPERATORS	CIVILIAN OPERATORS
NEUROLOGICAL DISORDERS		
Neurosyphilis of any form (general paresis, tabes dorsalis, meningovascular syphilis).	Neurosyphilis of any form (general paresis, tabes dorsalis, meningovascular syphilis).	Neurosyphilis of any form (general paresis, tabes dorsalis, meningovascular syphilis).
Degenerative disorders (multiple sclerosis, encephalomyelitis, cerebellar and Friedreich's ataxia, athetoses, Huntington's chorea, cerebral arteriosclerosis, muscular atrophies, and dystrophies of any type).	Degenerative disorders (multiple sclerosis, encephalomyelitis, cerebellar and Friedreich's ataxia, athetoses, Huntington's chorea, cerebral arteriosclerosis, muscular atrophies, and dystrophies of any type).	Degenerative disorders (multiple sclerosis, encephalomyelitis, cerebellar and Friedreich's ataxia, athetoses, Huntington's chorea, cerebral arteriosclerosis, muscular atrophies, and dystrophies of any type).
Residuals of infection (meningitis and abscesses, paralysis agitans, postencephalitic syndromes, Sydenham's chorea).	Residuals of infection (meningitis and abscesses, paralysis agitans, postencephalitic syndromes, Sydenham's chorea).	Residuals of infection (meningitis and abscesses, paralysis agitans, postencephalitic syndromes, Sydenham's chorea).
Peripheral nerve disorder (chronic or recurrent neuritis or neuralgia of an intensity which is periodically incapacitating, i.e., polyneuritis or neurofibromatosis).	Peripheral nerve disorder (chronic or recurrent neuritis or neuralgia of an intensity which is periodically incapacitating, i.e., polyneuritis or neurofibromatosis).	Peripheral nerve disorder (chronic or recurrent neuritis or neuralgia of an intensity which is periodically incapacitating, i.e., polyneuritis or neurofibromatosis).
Residuals of trauma (incapacitating residuals of concussion or cerebral trauma, post-traumatic cerebral syndrome, incapacitating injuries to peripheral nerves).	Residuals of trauma (incapacitating residuals of concussion or cerebral trauma, post-traumatic cerebral syndrome, incapacitating injuries to peripheral nerves).	Residuals of trauma (incapacitating residuals of concussion or cerebral trauma, post-traumatic cerebral syndrome, incapacitating injuries to peripheral nerves).
Paroxysmal convulsive disorders and disturbances of consciousness (grand mal, petit mal, psychomotor attacks and narcolepsy).	Paroxysmal convulsive disorders and disturbances of consciousness (grand mal, petit mal, psychomotor attacks and narcolepsy).	Paroxysmal convulsive disorders and disturbances of consciousness (grand mal, petit mal, psychomotor attacks and narcolepsy).
Miscellaneous disorders (spasmodic torticollis, brain and spinal cord tumors operated and unoperated, cerebrovascular disease, congenital malformations, including spina bifida if associated with neurological manifestations, meningocele even if uncomplicated, and Meniere's disease).	Miscellaneous disorders (spasmodic torticollis, brain and spinal cord tumors operated and unoperated, cerebrovascular disease, congenital malformations, including spina bifida if associated with neurological manifestations, meningocele even if uncomplicated, and Meniere's disease).	Miscellaneous disorders (spasmodic torticollis, brain and spinal cord tumors operated and unoperated, cerebrovascular disease, congenital malformations, including spina bifida if associated with neurological manifestations, meningocele even if uncomplicated, and Meniere's disease).

Comment

THE SOLUTION of the complex problem of motor terstate Commerce Commission, and the Motor Vehicle Licensing Bureaus. The proceedings of

vehicle accident prevention requires the combined efforts of many groups.

The improvement and maintenance of the road are the responsibility of the highway engineer.

Improvement in the design of the motor vehicle, stressing safety factors, is the responsibility of the automotive engineer.

Control of the driver and a better understanding of the human factors in accident causation are the responsibility of the physician.

It is essential that the public and professional groups be educated as to their responsibilities through all educational media.

The medical profession has started its educational program through meetings and the formation of committees to study this problem.

In October, 1954, the Industrial Medical Association appointed a committee to establish physical and mental standards for motor vehicle operators in an effort to prevent accidents.

In May, 1955, a conference on the Medical Aspects of Motor Vehicle Accident prevention was held in Montreal.[8]

In May, 1956, the New York University-Bellevue Medical Center, in cooperation with the Center for Safety Education sponsored a Symposium on the Medical Aspects of Motor Vehicle Accident Prevention. Attending this Symposium were authorities in medicine, engineering, public health, the judiciary, the safety agencies, the Insurance Industry, Motor Vehicle Administrators and Motor Vehicle Licensing Bureaus. The proceedings of this Symposium have been published.[9]

In 1956, the American Medical Association appointed a "Committee on Medical Aspects of Automobile Injuries and Deaths." The purpose of this Committee is to develop standards for vehicle operators, to aid in establishing research projects, and to educate the laity and physicians as to their importance in the prevention of motor vehicle accidents.

The Medical Society of the State of New York is cooperating with the Department of Health and the New York State Motor Vehicle Bureau in creating standards for motor vehicle operators and establishing a research center for study.

Carefully controlled research is necessary to determine the relationship between specific pathological processes and motor vehicle accidents. Research of this nature may require many years before definitive results can be obtained. In the meantime, it is essential that temporary or interim medical standards for motor vehicle operators be established. These criteria should be revised as data are obtained.

Summary

A LIST of interim recommendations for medical qualifications for motor vehicle drivers has been presented.

The need for continued research and education in this field of public health has been emphasized.

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symposium

MEDICAL ASPECTS OF MOTOR VEHICLE ACCIDENT PREVENTION

New York University-Bellevue Medical Center
and the
Center for Safety Education, New York University

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symposium

MEDICAL ASPECTS OF MOTOR VEHICLE ACCIDENT PREVENTION

New York University-Bellevue Medical Center
and the
Center for Safety Education, New York University

May 23, 1956

Conference Chairman

GEORGE E. ARMSTRONG, M.D.

Coordinator

HERBERT J. STACK, PH.D.

Program Chairmen

HAROLD BRANDALEONE, M.D.

LEON BRODY, PH.D.

Cooperating Agencies

COMMITTEE ON PUBLIC HEALTH, NEW YORK ACADEMY OF MEDICINE
NEW YORK STATE INDUSTRIAL MEDICAL SOCIETY
LOCAL MEDICAL SOCIETIES

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Preface

The symposium described in the following pages represents a pioneer effort in accident prevention in this country. Its objectives and program are set forth in the introductory presentations. However, there is need to point out that months of planning and arranging preceded the one-day meeting.

Outstanding specialists and administrators participated—a truly notable contribution of their invaluable time. But it should be noted that in advance of the one-day meeting, each participant received not only a list of fundamental discussion questions but also a number of items of medical and nonmedical literature on the subject (see page 3880), to make sure that they were acquainted with previous work and the present situation in regard to motor vehicle accident prevention. This was done in order to make the most efficient use of the symposium time in terms of the objectives that had been set for this one-day meeting.

This publication highlights the recommendations of eight workshop groups of specialists. Each report is the recommendation of the specific group, not the symposium as a whole. *Each report was prepared following free discussion. Where considerable difference of opinion arose, a minority report was prepared and is included herein.*

As was to be expected, the need for further research was emphasized throughout the separate group meetings. It was deemed advisable to bring these recommendations together in a special section of this publication (page 3879). Judging from these research needs as well as from the more immediate positive recommendations of the various groups, much remains to be done, and much can be done now—by the medical profession and others—in the interest of motor vehicle accident prevention.—HERBERT J. STACK, PH.D.

Address of Welcome

GEORGE E. ARMSTRONG, M.D., NEW YORK CITY

(Vice-President for Medical Affairs, New York University)

DURING our initial meeting to plan for this particular symposium, we had discussed whether or not it should last more than one day. Obviously we would like to have had it last longer because we felt there would be sufficient material for three or four days discussion, but we also knew that the individuals who were to be invited to attend and participate might spare one day but not two or three. And I should like to say at this point that we have been not only surprised but extremely gratified by the response. Not only was the reaction enthusiastic from those whom we asked to participate, but as word got around about this conference, we had any number of volunteers as additional participants. As a matter of fact, although we were unable to accept all who offered their services, the group has grown to approximately twice the size that we had initially intended.

All this is an indication of the significance of the problem of motor vehicle accident prevention. The highway safety record in this country certainly is not an enviable one. As a result the President of the United States has taken personal cognizance of the increasing seriousness of this problem and has urged all interested and appropriate parties to focus their attention upon this crisis.

It is well known that safety is affected by the nature and condition of our roads and by the characteristics and maintenance of the motor vehicle. The latter has been referred as "the misguided missile," which clearly implies the importance of the role of the motor vehicle operator insofar as safety is concerned. Unfortunately, despite increasing evidence that he is the major factor in accident causation, the driver has been more or less neglected from the point of view of preventive measures.

The present symposium is not the first indication of interest on the part of the medical profession. Certainly a great deal of work has been done in the area of crash injury effects and controls.

However, relatively little consideration has been given to medical aspects of motor vehicle accident *prevention* with particular reference to driver fitness. The medical profession for the most part has not been concerned with this matter, and only recently has it been considered an important problem in public health which requires the participation of physicians to achieve any solution.

Naturally, the role of the physician has medicolegal aspects, and we felt that it would be worth while at this time to have this phase of the subject discussed. It is evidence of this deep interest in the entire problem that the highest officer of our State, Governor Averell Harriman, has asked his Counsel, Honorable Daniel Gutman, to represent his office and the State's concern in this symposium. Judge Gutman will now take up the matter of medicolegal questions, and I am very happy to introduce to you a very distinguished citizen of our State, the Honorable Daniel Gutman.

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Legal Aspects

HON. DANIEL GUTMAN, ALBANY, NEW YORK

(Counsel to the Governor of the State of New York)

MAY I first bring you the greetings of the Governor of the State of New York, the Honorable Averell Harriman, who has asked me to extend to you his compliments for having arranged to meet here today to discuss these very serious problems.

I do not know how much legal opinion we can offer in relation to some of the matters with which you are concerned, particularly impairments of consciousness or other disabilities that may affect motor vehicle operation. What you are primarily anxious to establish is how to decide when an individual may be permitted to drive a motor vehicle and when he should be denied a license. Whatever I shall say on this point reflects, of course, only my own personal opinion. In general, such matters must be given careful thought and extensive study before recommendations are made that can be enacted into law. It is difficult to change laws, and the utmost care must be taken in seeking changes or new provisions.

In New York State the discretion to grant a license to an operator of a vehicle rests with the Commissioner of Motor Vehicles. If in his opinion it is an improper thing to do, he denies the application. If in his opinion it is safe to permit someone to drive, then he grants it, and with the exercise of sound discretion his opinions and his rulings have been upheld by the courts.

Now, what about individuals suffering from epilepsy or other organic and functional conditions that may affect the ability to drive? Even with affidavits and certifications from doctors, it is simple enough to understand the reluctance of an administrative official to assume the responsibility of determining whether the facts in a given case warrant issuance of a license. You may say, "Well, that's the Commissioner's job; that's his responsibility." That's right! But when his responsibility in one field must be coupled with an understanding of a science that is completely foreign—entirely foreign to his own administrative duties—then responsibility must be shared by others. The sharing must be done by the medical profession.

The problem is this: If the Commissioner grants a license in a borderline case and the subsequent driving record of this individual is clear, no questions are raised. However, should there be one serious accident caused by the driving of an individual where condition has been certified to be under control for purposes of motor vehicle operation, you can very well imagine the criticism that would be heaped on the Commissioner and on the physician.

From the physician's point of view, in certain cases it is difficult for him to determine with a reasonable degree of certainty whether he should certify as to the patient's ability to drive a motor vehicle safely. In any event, under the laws that apply today, he would be liable unless he were reasonably sure of his ground. That is perhaps the simplest way to put it from the point of view of a layman. Underlying the laws relating to liability of individuals for their doings is the principle of reasonable action, reasonable conduct, reasonable understanding. The same principle applies to a lawyer in his practice of the law, to a physician in the practice of medicine, and to practically every other area of activity. But reasonable standards may not be sufficient when dealing with a condition which may act to the subsequent danger of other people. In such a case reasonable care might be interpreted by the lay jury as meaning, perhaps, extraordinary care in spite of anything the judge might tell the jury in following the dictates of the law.

This situation, insofar as driver licensing is concerned, may be remedied by setting up minimum standards and by providing in the law that certain procedures are to be followed and certification made by the physician as to the condition of a license applicant. In such case he would be relieved from liability since he would be conforming to legal requirements. It all depends on the extent to which you can work out minimum standards to which you can certify with reasonable certainty and which, in the opinion of the profession, should satisfy requirements under present-day conditions.

Another remedial measure is to provide for administrative procedure as is done in some states.

This entails granting a license to doubtful or borderline cases for a period of six months or less than a year, with the requirement of periodic examination or with a board passing on the capacity of an individual. Such a board should consist of the Motor Vehicle Commissioner or his representative and representatives of the medical profession, including psychiatrists and any other specialists that you feel should sit on a board of this kind.

Toward such ends as these, I believe it is of the utmost importance that leading members of the medical profession, motor vehicle commissioners, and specialists in traffic safety are meeting in this symposium to work out standards and procedures that are sound and fair to all concerned.

The Mission of This Symposium

HAROLD BRANDALEONE, M.D., NEW YORK CITY

(Medical Director, Third Avenue Transit System and United Parcel Service, and Assistant Clinical Professor of Medicine, New York University College of Medicine)

THE record of motor vehicle accidents in this country is appalling. In 1955 there were almost 40,000 people killed on our streets and highways, almost a million and a half injured, and more than four billion dollars worth of property damage.[1]

It is the mission of this symposium to help prevent these motor vehicle accidents by formulating physical and mental standards for the licensing of drivers. Today we have made an effort to bring together persons best qualified to accomplish our purpose. Attending this meeting are physicians, safety experts, engineers, licensing commissioners, highway commissioners, members of law enforcement agencies, members of the legal profession and the judiciary, representatives of industry, officials of the Interstate Commerce Commission, the armed forces, and other Federal agencies, and others interested in motor vehicle accident prevention. It is our hope that this group will work together and establish a set of standards and recommendations to prevent accidents and recommend research for future studies.

We realize the great need for basic research in establishing the relationship between driver fitness and accident prevention. However, until such data are obtained, there is need for an interim guide of physical and mental criteria in an effort to curb the great loss of life and tremendous number of injuries that occur on the highway.

Accordingly, the present symposium was arranged with the following objectives:

1. To review present knowledge concerning medical and psychologic factors in traffic accident causation.

2. To consider this knowledge and the opinion of medical specialists in relation to driver licensing, *with particular reference to the feasibility of establishing physical and mental standards for motor vehicle operators.*

3. To present these facts and opinions to all concerned with traffic safety, emphasizing the importance of preventive measures and the need for careful research into all relevant aspects.

The first two objectives, and particularly the second, will be considered today by workshop groups of specialists organized as follows:

Group 1. Psychiatric-Psychologic Aspects (accident-disposing factors or behavior patterns; methods of detection or screening)—Herbert S. Gaskill, M.D., *Chairman*, Director of Psychiatric Services, University of Colorado Medical Center.

Group 2. Organic Medical Aspects (including cardiovascular, neurologic, ophthalmologic, diabetic, geriatric, orthopedic, and medicolegal aspects considered by subgroups)—Irving Graef, M.D., *Chairman*, Associate Professor of Clinical Medicine, New York University Post-Graduate Medical School.

Group 3. Drug and Chemical Aspects (alcohol, stimulants, depressants, and antihistamines)—David B. Dill, Ph.D., *Chairman*, Scientific Director, Chemical Corps Medical Laboratories, Army Chemical Center.

The recommendations of these groups will be presented at a general evening session intended primarily to contribute to the third stated objective.

In the workshop sessions emphasis should be placed on the feasibility of establishing physical and mental standards for licensing private vehicle operations. It is also considered desirable to attempt to formulate more rigid standards for public vehicle operators, who have responsibility for safe transportation of passengers, and for commercial vehicle operators or truck drivers. Obviously, there can be no intention to deprive any individual of the privilege to drive or to earn a livelihood by driving unless lack of proper qualifications render him a threat to life and limb.

Of necessity, recommendations cannot be too lenient or too rigid or unrealistic. Furthermore, the commercial vehicle operator has other duties besides driving which must be taken into account (e.g., lifting heavy objects).

A note of optimism for motor vehicle accident prevention is to be found in industrial reports[2,3] indicating that a conscientious medical evaluation of driver fitness can reduce motor vehicle accident rates as much as 50 per cent. There is reason to believe that this record can be improved and, furthermore, that successful application of medical standards and other driver selection procedures can be made so as to reduce substantially the accident rate of the general driving public. It is hoped that the recommendations of this symposium may be a contribution in this direction.

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Committee Reports

Group I: Psychiatric-Psychologic Aspects

HERBERT S. GASKILL, M.D., *Chairman*, Director of Psychiatric Services, University of Colorado Medical Center

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JOSEPH M. BOBBITT, M.D., Chief, Professional Services Branch, National Institute of Mental Health, U.S. Public Health Service

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HENRY BRILL, M.D., Assistant Commissioner, Department of Mental Hygiene, State of New York

LEON BRODY, PH.D., Director of Research, Center for Safety Education, Division of General Education, New York University

BASIL R. CREIGHTON, Assistant Executive Director, American Association of Motor Vehicle Administrators

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T. W. FORBES, PH.D., Program Director-Highway, American Institute for Research

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MAXWELL HALSEY, Safety and Traffic Advisor, Eno Foundation for Highway Traffic Control

VERNE K. HARVEY, M.D., Medical Director, Bureau of Departmental Operations, United States Civil Service Commission

WILLIAM J. HILLIARD, Acting Deputy Commissioner, Department of Motor Vehicles, State of Connecticut

JOSEPH P. KELLY, Commissioner of Motor Vehicles, State of New York

BARRY G. KING, PH.D., Deputy Director, Commission on Accidental Trauma, Armed Forces Epidemiological Board

ROBERT F. KORNS, M.D., Assistant Commissioner of Health, State of New York
MERWYN A. KRAFT, Director, Department of Personnel and Accident Prevention, American Transit Association
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JOHN MACIVER, M.D., Health and Welfare Division, Metropolitan Life Insurance Company
JOHN O. MOORE, Director, Automotive Crash Injury Research Project, Cornell University Medical College
JOHN M. MURTAGH, Chief Magistrate, City of New York
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JAMES WALL, M.D., Director, Westchester Division, New York Hospital
G. R. WENDT, PH.D., Chairman, Department of Psychology, University of Rochester
WALTER D. WOODWARD, M.D., Psychiatrist, American Cyanamid Company
LT. COL. WILLIS H. WOOD, Executive Officer, Office, Assistant for Ground Safety, DCS/P, Department of the Air Force

The group held an extensive discussion of the progress made in psychiatric and psychologic fields as they relate to the licensing and improvement of the motor vehicle driver. General agreement was reached that driver attitudes and personality characteristics have a major role in the causation of traffic accidents and that research in this area should be continued and intensified.

It was recognized, however, that knowledge in the psychiatric and psychologic fields has not yet reached the point where it can be effectively applied in the form of specific requirements or standards for licensing private motorists. Nevertheless, psychologic examinations should be employed as much as possible in driver research programs of motor vehicle departments. The findings of such research could be used to advantage in driver education and driver-improvement activities. Simultaneously, such research facilities might help to identify individuals with extreme conditions, and as a result the motor vehicle administrator would have a basis for referring such individuals to professional facilities where more intensive and more objective evaluation could be made of their fitness to drive.

It is therefore recommended by this conference group that:

I. In considering license applications, motor vehicle administrators should be as selective as is feasible and defensible, in order to increase the possible contribution of the license-granting procedure toward the elimination of unsafe drivers.

II. Motor vehicle administrators should consider giving a longer and more comprehensive examination to a random sample of license applicants, the data to be coded on their basic driving record and studied with respect to the subsequent performance of these drivers.

III. It be affirmed that the only acceptable kind of psychologic and psychiatric evaluation of drivers is that which involves a "whole" personality assessment as distinguished from single test measurements.

IV. Educational efforts be promoted that will help to bring public opinion to support appropriate and defensible limitations of the driving privilege.

V. State governments provide competent manpower and adequate facilities for the proper upgrading of the whole field of driver licensing, including the implementation of the results of research into the psychiatric-psychologic aspects of the accident problem. This would require, among other things, the employment of qualified examiners in sufficient numbers to carry out an adequate prelicense and postlicense examination of drivers.

VI. States and cities establish research centers for the psychiatric and psychologic examination of drivers whose records of accidents and/or violations bring them before the courts and/or the motor vehicle commissioner and who may then be referred to such centers for intensive examination of their fitness to drive. This is proposed to the end that the courts and the licensing authority may have additional information regarding the qualifications of such people based

on scientific evidence of their mental and physical abilities.

VII. Since from a psychologic point of view the physician exercises a great influence over the mind and therefore the conduct of the average individual, the physician be urged to give more attention to cautioning patients against driving a motor vehicle when suffering from disease apparently impairing mental or physical ability to drive or when such ability is likely to be impaired by reason of treatment.

Although the above report indicates that few specific recommendations can be made at this time regarding the detection and rehabilitation of problem drivers, it should be noted, as was brought out during the group discussion, that there has already been a substantial amount of research on particular aspects of the problem. Much of this research has been on the significance of isolated characteristics, such as reaction time and visual acuity. The findings have been largely negative—that is to say, no significant difference has been found between good drivers and problem drivers in these respects. A sampling of these and other research studies is included in the list of references below.

In the light of such findings several members of the group emphasized again the need for objective-type tests of driver attitudes, which would help to identify aggressiveness, irresponsibility, resentment against authority, and other undesirable characteristics that may be evidenced on the road as well as in other areas of everyday activity.

One of the important questions that was discussed without agreement as to its disposition had to do with possible restrictions on the licensing of individuals with histories of mental illness. Some states, including New York, require a license applicant to indicate if he has ever been confined to a hospital or institution for mental illness. However, doubt was entertained as to the reliability of the responses, and in any case there was disagreement as to the conditions under which such a history would warrant a limited licensing or rejection of license application. This is undoubtedly an important area for further study. Consideration must be given also to the administrative and professional procedures for the information of the motor vehicle authority if and when disqualifying or limiting criteria are set up in connection with mental illness.

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Group II: Organic Medical Aspects

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General Medicine Committee

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I. This group recommends that the model Motor Vehicle Code proposals relating to minimum age for licensing private motor vehicle operators be accepted—this age is sixteen; also, Interstate Commerce Commission's regulations relating to minimum age for licensing commercial motor vehicle operators be maintained. This varies from eighteen to twenty-one years, depending on the type of license.

II. The group believes that comprehensive data based on exposure and risk, relative to the effects of the organic aging process on the production of motor vehicle accidents, do not exist. In light of present information it is not known what effect organic disease or the aging process actually has on the motor vehicle accident rate because existing data do not take into account alcoholism, mechanical difficulties, road conditions, or the mental status of private drivers who have accidents. The group feels that detailed, objective studies in this area are badly needed.

III. The group is in agreement that periodic screening and other types of examinations are desirable for older people and believes that studies should be made to determine the types of examination, periodicity of examination, and ages at which such examination should be mandatory.

IV. The group believes that the motor vehicle operator who is responsible for a police-investigated accident should have his license suspended. It should not be renewed until the motor vehicle commissioner is satisfied that the individual's physical and mental status is satisfactory for operating a motor vehicle.

V. The problem of evaluating physical and mental standards needed for motor vehicle licensure varies somewhat according to whether one is considering commercial or private operators.

VI. The group accepts with reservations the outline[1] of disease entities preliminarily presented to it as possible bars to the employment of *commercial motor vehicle operators*. The reservations of the group arise from a belief that there should be more study and definition of the effects of the proposed disease entities on employment and in relation to accidents.

VII. The group wishes to emphasize that there are a number of disabling organic physical defects which should restrict the issuing of *private motor vehicle licenses*, such as conditions which produce a sudden loss of consciousness or other inability to operate a motor vehicle safely. However, the group believes that it is not in a position to bring in specific recommendations relative to organic physical deviations from the average because of the lack of comprehensive data on the effects of many organic physical defects in the causation of accidents. The group recommends that the American Association of Motor Vehicle Administrators, the Interstate Commerce Commission, and other interested groups, in association with representative members of the medical profession, undertake studies to determine specific disabilities which would limit the ability of an individual to operate safely an automobile.

VIII. The group recommends that state motor vehicle administrators be authorized to appoint specialist panels to advise them relative to those disabilities which would restrict the

* *Ex officio* members

issuance of motor vehicle operator licenses.

IX. The group recommends that qualifying medical examinations be mandatory prior to the first issuance of a license to an individual and that a periodic qualifying medical examination be given prior to each renewal of the license.

X. The group recommends that when a condition which precludes the safe operation of a motor vehicle develops in an individual, his physician should inform the patient about the danger of his operating a motor vehicle.

Minority Report

A minority of the General Medicine Committee agrees with the scientific approach of the group's report, recommending more study to ascertain the relationship between specific organic disease of the driver and the etiology of motor vehicle accidents. However, this minority disagrees with the remainder of the committee who recommend delaying the establishment of criteria for driver fitness until adequate research is completed.

The minority, consisting of the industrial physicians on the committee, believe that a list of interim criteria for driver fitness can be established immediately on the basis of available knowledge and experience, without waiting for the results of further research in areas of insufficient knowledge.

Industrial physicians have shown[2,3] the value of establishing medical criteria in driver selection in industry. The application of such criteria to the selection of all drivers would be beneficial in reducing the accident rate and would assist the licensing authorities in granting licenses.

The Massachusetts Registry of Motor Vehicles already has an extensive program for licensing "special risk drivers." Licenses are granted for short periods (three months) after examination by qualified specialists. Periodic examinations are required for renewal of such licenses. Rigid criteria are maintained for subjects with epileptiform disorder, diabetes mellitus, known mental illness, and neurologic diseases.

Careful selection and licensing of drivers may be important means of controlling accidents. The license bureau, by establishing rigid criteria, can exert mandatory and discretionary control. Insurance companies, by refusing to insure cars driven by unsafe drivers, can also aid in reducing accidents.

Rigid standards for granting licenses might impose a hardship on some individuals but would help reduce the large number of injuries and deaths that occur on the road. This is an obligation we owe the public for their safety.

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Committee on Cardiovascular Diseases

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The committee realizes the lack of conclusive statistical data concerning the role of each cardiac condition as a potential driving hazard. However, based on our knowledge of pathologic physiology and the clinical course of certain cardiac conditions, we feel that a medical opinion can be formulated as to their potential danger. We have listed as disqualifying those conditions which we consider possible sources of danger due to sudden loss of consciousness, inability to continue normal function, or death. There can be little argument that such categories as aortic stenosis, congestive heart failure, and Adams-Stokes syndrome are disqualifying. Where there is doubt as to whether a condition mitigates against driving, we have used the term "to be evaluated" to show that the ultimate decision may depend on other limiting factors or further study of the patient.

Realizing the needs of those in licensing bureaus, industry, and transit associations, we feel that it is a responsibility of the medical profession to offer its help by suggesting, where possible, specific conditions they consider disqualifying.

The disqualifying conditions differ for the three categories of vehicle operation: public transportation, commercial, and private. Since transportation vehicle operators are responsible for passenger safety, the physical requirements are more stringent. As for commercial vehicle operators the nature of their work has to be considered in the evaluation of limiting cardiac factors. For instance, a person with slight diminution of his cardiac reserve might be able to drive a vehicle without danger. If, however, his job as a commercial vehicle operator imposed such physical demands on him, e.g., climbing in and out of trucks or lifting heavy objects, that his cardiac reserve would be strained after a few hours of work, the operator could become a driving hazard.

The Committee on Cardiovascular Diseases suggest the following conditions as disqualifying for operators of vehicles in each of the indicated categories:

Private Operators

1. Severe diminished cardiac reserve.
2. Congenital heart disease—to be evaluated.
3. Aortic stenosis.
4. Organic valvular disease—to be evaluated.
5. Coronary artery disease with complications—to be evaluated.
6. Aneurysm of any centrally located or major vessel.
7. Adams-Stokes syndrome.
8. Complete auriculoventricular heart block or incomplete auriculoventricular heart block, with dropped beats.
9. Hypertension, with complications.
10. *Fixed* hypertension above 180/100.
11. Uncontrolled paroxysmal auricular fibrillation or flutter, or tachycardia.
12. Orthostatic hypotension, if symptomatic.
13. Carotid sinus syndrome with vertigo or syncope.
14. Cerebrovascular disease with or without paralysis.

Commercial Vehicle Operators

1. Active rheumatic fever.
2. Diminished cardiac reserve with organic heart disease.
3. Congenital heart disease—to be evaluated.
4. Aortic stenosis.
5. Organic valvular disease—to be evaluated.
6. Coronary artery disease with complications—to be evaluated.
7. Aneurysm of any vessel.
8. Uncontrolled paroxysmal auricular fibrillation or flutter or tachycardia. Ventricular arrhythmia other than premature contractions.
9. Adams-Stokes syndrome.
10. Complete auriculoventricular heart block or incomplete auriculoventricular heart block, with dropped beats.
11. Hypertension, with complications.

12. *Fixed* hypertension above 180/100.
13. Thrombophlebitis, with evidence of circulatory obstruction or recurrence.
14. Orthostatic hypotension, if symptomatic.
15. Carotid sinus syndrome with vertigo or syncope.
16. Cerebrovascular disease, with or without paralysis.

Transportation Operators

1. Active rheumatic fever.
2. Diminished cardiac reserve with organic heart disease.
3. Congenital heart disease—to be evaluated.
4. Hypertrophy and dilatation of the heart, confirmed by x-ray—to be evaluated.
5. Aortic stenosis.
6. Organic valvular disease—to be evaluated.
7. Coronary artery disease with coronary insufficiency and/or myocardial infarction.
8. Pericarditis, myocarditis, and endocarditis—to be evaluated.
9. Aneurysm of any vessel.
10. Adams-Stokes syndrome.
11. Uncontrolled paroxysmal auricular fibrillation or flutter or tachycardia. Ventricular arrhythmia other than premature contractions.
12. Complete auriculoventricular heart block or incomplete auriculoventricular heart block, with dropped beats.
13. Hypertension, with complications.
14. Fixed hypertension above 180/100.
15. Thrombophlebitis, with evidence of circulatory obstruction or recurrence.
16. Orthostatic hypotension, if symptomatic.
17. Carotid sinus syndrome with vertigo or syncope.
18. Cerebrovascular disease, with or without paralysis.

The only minority disagreement occurred in the setting of a specific level of blood pressure for disqualification. It was the opinion of the minority group that there was no medical basis for the adoption of any definitive disqualifying blood pressure level in the absence of vascular complications.

The committee as a whole recommended that the safety records of cardiac drivers be compared with the records of noncardiac drivers.

The committee also recommended the evaluation of specific detailed medical data relating to etiologic, anatomic, and physiologic cardiac defects in drivers involved in accidents.

Committee on Neurologic Disorders

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This committee considered neurologic disorders and their relationship to the ability of the individual to operate a motor vehicle with safety. It became immediately obvious that research into the short-term and long-term liability of many of these disorders is urgently needed. We believe that state and Federal governments should provide funds for research, so that more exact information will be available and, hence, clearer recommendations can be made.

In order to judge the ability of an individual with a neurologic condition to drive with safety, the applicant should submit through his physician a complete history of the applicant's condition and report of pertinent neurologic and laboratory findings.

With respect to epilepsy the committee believes it wiser to use the term "epileptiform type of seizures," these being defined as any condition which brings about transient lapse of consciousness and/or loss of motor control and which may become chronic. In states which have adopted machinery for careful screening of individuals suffering from these disorders, the frequency of traffic accidents has been sharply reduced. In addition, accidents from these causes are minimal as compared with certain other medical conditions, such as alcoholism and impulsive behavior. (For example, in Massachusetts in the last three years epileptiform seizures have not been responsible for a single fatality, whereas alcohol has caused 265.)

The committee does not believe that seizures should be made reportable to health authorities. This would lead to subterfuge and increased secrecy. Judgment of persons with a history of seizures should be based on the evaluation of various conditions. These include the person's age when seizures began, the type and frequency of past seizures, the elapsed time since the last attack, presence or absence of an invariable and sufficiently prolonged aura, or of attacks limited to sleep; the person's sense of social responsibility, his sobriety, and his veracity; the adequacy of his medical treatment and his faithfulness in following such therapy; the presence or absence of physical, neurologic, or mental disability; the degree of abnormality of the electroencephalogram; and the type and extent of his proposed driving. The question to be faced is whether, considering the sum of these conditions, there is likelihood that the applicant will experience a seizure while driving. Of these various conditions absence of any seizure for a period of from eighteen to twenty-four months is basic.

As regards all neurologic conditions and particularly those involving disturbances of alertness in consciousness, the commissioner should have the assistance of a panel of physicians who are experienced in the diagnosis, treatment, and management of such disorders and neurologic diseases. These specialists would evaluate the report submitted by the applicant's physician, examining the applicant if necessary, and advise the commissioner whether in their opinion it is safe for the person to operate a motor vehicle.

The procedure, as outlined, would accomplish the following:

1. It would serve as a screening device to protect the public, to protect the applicant's physician from possible threat of suit, and to protect the applicant himself.

2. It would permit special restrictions (such as a lengthened period free of attacks) for cases with undue exposure to risk. Drivers of private cars have less exposure than those who operate vehicles for commercial use or for public transportation under adverse working conditions and fixed schedules.

3. The aim of this evaluation is to determine the capacity of the individual to drive safely rather than to limit individuals solely on the basis of a diagnostic category. The diagnostic label would merely alert the motor vehicle bureau. It should not be grounds for refusal of a license because it does not indicate the degree of the physical or mental disability of the individual.

Periodic re-examinations and re-evaluations of the functional capacity of the individual are necessary to determine his continuing ability to drive safely.

The medical advisory group to the commissioner would recommend either approval, approval subject to periodic re-examinations, or else disapproval of a license. The commissioner could then accept or reject the advice at his discretion.

. . .

The above report was prepared by Dr. William G. Lennox for the Committee on Neurologic Disorders. Dr. Harold G. Wolff, chairman of the committee, who had to leave before the meeting was ended, subsequently reviewed the report and made the following observations:

The report expresses the consensus except on certain issues, which are as follows:

1. Several of the committee (including Dr. Wolff) strongly adhere to the view that persons who have had epileptiform type of seizures, whether due to known causes, such as brain injury or brain tumor, or unknown causes, should be excluded from the privilege of driving public transport vehicles. In exceptionally rare and special instances individuals who have had such seizures *in infancy only* should be considered as candidates for licenses to drive such vehicles.

2. The committee was divided concerning whether the foregoing restriction should include drivers of commercial motor vehicles, but most felt that a stringent surveillance and repeated examinations by an expert should be

required, the nature of the details of the control remaining to be worked out. Certainly a patient should have been free of seizures for a period of five years before his application could be seriously considered, and should be encouraged, if possible, to pursue another occupation. (Dr. Wolff adds that he is of the personal opinion that drivers of commercial vehicles should be subject to the same restrictions as in number 1.)

3. Several of the committee (including Dr. Wolff) feel that acceptance of eighteen to twenty-four months of freedom from seizures as a basic requirement for licensing for private car driving is too short. It should be at least three to five years.

Committee on Visual Standards

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We recommend that the usual three main categories of public transportation, interstate commerce, and private car operators be changed so as to combine public transportation and interstate commerce personnel into one group.

I. The following are our recommendations for the minimal visual standards for the first group (public transportation and commercial operators):

A. A correctable visual acuity to 20/30 Snellen in each eye. If corrective glasses are required for obtaining visual acuity of 20/30, unbreakable glasses or an extra pair of glasses should be mandatory.

B. Form fields of 70 degrees in the horizontal meridian with each eye and 140 degrees in the horizontal meridian with both eyes.

C. No requirement for color vision indicated. However, it is recommended that the shape, size, position, and color of traffic lights be standardized.

D. No requirement for stereopsis (depth perception) indicated or recommended.

E. No test for light sense recommended but the presence of night blindness should be excluded by direct question.

F. Mandatory yearly examinations under the supervision of a qualified eye examiner.

II. The following are recommended as the minimal requirements for private car operators:

A. A correctable visual acuity to 20/40 Snellen in one (the better) eye.

B. Form field of 70 degrees in the horizontal meridian in each eye or 140 degrees in the horizontal meridian in one eye.

C. Re-examination of eyes every three years.

III. The following recommendations are considered pertinent to the broad role of vision in safe motor vehicle operation:

A. There is need for greater recognition and correction of present inequalities in related state laws.

B. Further consideration must be given to such mechanical factors as the following:

1. Vehicle design (windshield bars, wipers, blind spots, etc.).
2. Lowered visibility in use of tinted windshield and/or use of tinted glasses for night driving.
3. Reflections inside the car (chrome, etc.).
4. Rear window and mirrors.
5. Visibility of moving objects on road or roadside.

C. Consideration should be given to the advisability of requiring parties involved in a serious accident to undergo more extensive medical (including visual) and mental examinations under duly qualified examiners to evaluate their fitness to continue to drive.

D. No specific recommendations are made at the present time in regard to color vision, stereopsis, and light-sense because of the lack of uniformly acceptable tests.

E. Consideration should be given to further research concerning the relation between the causes of accidents and depth perception (stereoscopic vision), muscle balance, and particularly visual and mental reaction time.

F. It is recommended that every commissioner of motor vehicles have available qualified eye consultants for consideration of all visual problems, including limited license and hardship cases.

G. It is recommended that the licenses of all individuals receiving aid for the blind be revoked.

Great emphasis must be placed on further evaluation of total environmental factors in accidents and on scientific determination of the perception and proficiency of drivers.

Committee on Auditory Standards

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It was the feeling of the committee that the observance of stricter criteria of fitness to drive would result in the reduction of the appalling rate of motor vehicle accidents. Toward this end certain recommendations were made regarding standards and test procedures pertaining to hearing qualifications of driver license applicants.

A simple test easily applied by laymen, the object of which would be to screen out those individuals with severe hearing loss, should be utilized.

1. Spoken voice test using recommended standard test words should be employed.
2. Minimum requirements for passing would be 50 per cent of the words correctly repeated at a 5-foot distance in the better ear.
3. On failure to pass this test, the applicant would be required to undergo an audiometer evaluation test by a safety clinical committee of physicians established by licensing authorities. It would be the responsibility of this committee to determine the applicant's physical fitness for safe driving.

The standards which would guide this committee would be determined after further study by national organizations directly concerned. It is recommended that:

1. Applicants be given hearing tests as outlined above.
2. Those over sixty-five years of age be reexamined at each license renewal period by the committee.
3. Repeat offenders and those with known

physical defects be evaluated by the committee as to their fitness to drive.

Vertigo is recognized as a potential cause of accident. However, in the experience of members of the group, no single incident is known in which vertigo was a contributing factor. Warning symptoms are usually present sufficiently in advance to give the operator an opportunity to pull over to the curb or off the highway. It is important for physicians caring for patients subject to sudden attacks of vertigo to warn them of the danger of operating a motor vehicle.

In the licensing of *operators of passenger vehicles*, audiometric tests should be mandatory. It is recommended that a hearing loss for the speech frequency in the better ear, aided or unaided, should not exceed 30 decibels. Periodic examination of hearing is recommended for this group.

1. If an operator's hearing is corrected by the use of a hearing aid, the individual should be required to wear it at all times during the operation of a motor vehicle.

2. Total loss of hearing in one ear is considered disqualifying for employment.

3. Aphonia and severe speech defect are considered disqualifying.

4. An individual subject to sudden unpredictable attacks of vertigo (Ménière's disease or other vestibular disturbance) should not be employed for the operation of any passenger transportation vehicle. When the disease develops during employment, the employe should be disqualified from operating a vehicle. However, if the disease is subsequently considered to be cured or under control, the final decision as to fitness to return to work should be determined after evaluation by the safety clinical committee.

Insofar as *operators of commercial vehicles* are concerned, the same recommendations should apply as for the operator of a passenger transportation vehicle, with the following exceptions: (1) the maximum acceptable hearing loss for the speech frequency in the better ear, aided or unaided, should not exceed 50 decibels, and (2) there should be no restriction for voice or speech defects.

Committee on Orthopedic Standards

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PHILIP WILSON, JR., M.D., Assistant Professor of Clinical Surgery, Cornell University Medical College

It was the considered opinion of this group that the following recommendations should constitute minimum orthopedic standards for the licensing of drivers of motor vehicles.

I. *Conditions of the Head and Neck:* Conditions of the head and neck, such as torticollis, cervical rib, scalenus anticus syndrome, osteoarthritis, Marie-Strümpell arthritis, and cervical disk degeneration, which through pain or associated neuromuscular deficit, cause limitation of motion of the head and neck, such as to result in a loss of rotation to either side of 75 per cent or more, are likely to interfere with proper operation of all types of vehicles. If the rotation to either side is limited to between 50 and 75 per cent of normal rotation, passenger car operation should be permitted. If between 75 and 100 per cent, commercial vehicle operation is permissible. To operate public transportation vehicles properly and safely, normal rotation to either side should be required.

II. *Diseases of the Thoracic Cage:* Active infection of the thoracic cage, such as active osteomyelitis with draining sinuses, should preclude the operation of commercial or public transportation vehicles. These conditions as

such are no contraindication to the operation of private passenger cars, providing the individual's general physical condition is satisfactory. It is also felt that scoliosis, kyphosis, lordosis, and combinations of these conditions, if of mild to moderate severity, are no contraindication to the operation of all three types of vehicles. Severe conditions preclude the operation of commercial and public transportation vehicles. However, there is no objection to the operation of private passenger vehicles under these circumstances.

III. *Upper and Lower Extremities:* It is felt that the upper extremities must be essentially normal in order to operate commercial or public transportation vehicles. A one-armed person with normal lower extremities may drive a passenger vehicle, provided the one arm has normal function and suitable auxiliary operational devices are available.

It was felt that complete normal function of the lower extremities was necessary for the safe operation of commercial and public transportation vehicles. Persons with one lower extremity entirely normal should be able to operate a standard passenger motor vehicle. However, individuals with one lower extremity totally disabled either through loss or paralysis, plus significant impairment of function of either hip, knee, or ankle on the opposite side, should have hand controls plus two good upper extremities. Persons with one normal upper and one normal lower extremity are considered capable of operating modified passenger cars, as are persons with two good upper and no lower extremities.

A minority of the committee was of the opinion that a greater percentage of total upper extremity function should be required than of total lower extremity function.

IV. *Spine:* Painful conditions of the low back plus infections of the spinal column should preclude the operation of commercial and public transportation vehicles. However, these conditions do not preclude the operation of private passenger vehicles, providing no significant neurologic deficit exists bilaterally.

Miscellaneous conditions which, by virtue of their pain-producing mechanisms, interfere with function should be considered as precluding the operation of motor vehicles. Included are conditions such as osteoarthritis and rheumatoid arthritis.

V. *Additional Recommendations:* Over a period of years the Veterans Administration has provided thousands of automobiles equipped with special controls to amputees, paraplegics, and veterans with other orthopedic disabilities. But little is known regarding the accident experience of these drivers.

It is recommended that in cooperation with state motor vehicle administrators, the Veterans Administration conduct a study of the driving record of these individuals. It is further recommended that state license authorities, whenever possible, maintain separate files of all drivers who use special controls on vehicles.

Group III: Drug and Chemical Aspects

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I. *Recommendations Concerning the Use of Chemical Tests for Alcohol**

Since adequate research facilities are not available to study the changes in human behavior brought about by brain alcohol in various concentrations, this committee recommends that when a driver has become involved in a motor car accident or traffic violation, his blood, urine, saliva, or breath be tested for alcohol. On refusal by the driver or if alcohol is detected, a demerit mark should be placed on his driving record. In case of a second accident, if alcohol is again detected or if he again refuses, the driver's license should be indefinitely suspended while the driver's drinking habits are investigated by a clinician appointed by the authorities. The driver may be reinstated at the discretion of the licensing authorities.

II. Recommendations for Further Research on Alcohol†

A. Studies to relate objective measures of driver performance to levels of alcohol in the individual. For example, driver performance may be graded in the following categories:

1. Not apprehended by authorities.
2. Apprehended for traffic violations only.
3. Apprehended for nonfatal accidents.
4. Apprehended for fatal accidents.

The last three items can be analyzed from data already available from jurisdictions where such studies have been and are being conducted. The first would involve a carefully controlled study of drivers not apprehended or involved in any accident.

B. Studies to distinguish the differences in driver performance which are related to (1) the pharmacologic actions of alcohol and (2) the inherent behavioral tendencies of individuals who choose to use alcohol in varying degrees.

C. Chemical and pharmacologic studies to determine the metabolic products formed in a person who has had a quantity of alcohol in his body which might impair his driving ability. In other words, is the significance of a specific concentration of alcohol in the blood, such as 0.15 per cent, the same in an individual who has recently imbibed enough alcohol to bring him up to that level as in one who may have had a larger concentration of alcohol some time previously but is in the downward portion of the curve of alcohol concentration?

III. *Recommendations Covering Drugs and Automobile Operation*

The relation of drugs (other than alcohol) to automobile driver behavior is too little understood to justify specific recommendations at this time. It seems clear, however, that many commonly used drugs, including antihistamines, antisoporifics, and sedatives, when used in normal doses, may harmfully affect automobile driving. Enough evidence is available to give guidance to the medical profession and to the public. In consideration of this it is recommended:

A. That Federal, state, and private agencies, industry, and universities support research on the psychologic and physiologic effects of commonly used drugs and on their relationships to automobile driver behavior.

B. That the medical profession be educated in

* Prepared by Dr. Lucas, Dr. Dill, and Mr. Alexander.
† Prepared by Dr. Freireich.

adapting their prescriptions of such drugs to the occupation of the patient and in giving patients proper warning of possible effects on driving.

C. That the public be educated to the fact that many medicines, not just a few, have effects on automobile driving.

D. That research be conducted on the possibility of legal control of use of drugs in relation to driving.

IV. *Recommendations Concerning Education of the Medical Profession and the Lay Public on How Alcohol and Commonly Used Drugs Affect the Automobile Driver*

A. Medical profession:

1. The profession needs to be informed concerning the existing law and the meaning and significance of chemical test evidence in order to aid the physician in making diagnoses and testifying effectively in court.

2. The profession needs to be informed concerning the functions involved in operating a motor vehicle and the effects of alcohol and drugs on these functions, so that the physician can better operate as an educational force both with the individual patient and in his public relations with the community.

3. It is recommended that efforts in this direction be activated initially in national, state, and county medical societies, encouraging them to direct effective propaganda to constituent members.

B. Public (nonmedical):

1. Law enforcement agencies (police, judges, prosecutors, etc.), industrial groups (including the drug and liquor manufacturers), and insurance companies need to be informed concerning the effects of drugs and alcohol on motor vehicle operation. Some framework or agency should be established through which these needs can be satisfied.

2. There is a basic need for knowledge and understanding by the layman on how small or moderate amounts of drugs or alcohol specifically affect driving functions. Only such understanding will justify existing laws in the mind of the layman; he will continue to support and obey only the laws he understands. Such education can be propagated through textbooks, better informed school teachers, popular newspaper and magazine articles, and the other media of public information. In the long run such education can change existing attitudes with regard to the use of alcohol and drugs in relation to driving. Ultimately there will have to be a change from the present lack of social stigma attached to such practice.

The Importance of Accident Prevention

HOWARD A. RUSK, M.D., NEW YORK CITY

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WHEN we were setting up the early veteran and civilian rehabilitation programs here in New York and then generally throughout the country, I was astounded by one statistic that I have never been able to get out of my mind. The bloodiest fighting that we had in the war and the days of our highest casualties were the first ten days after D-day. We lost, killed and wounded, on the beachheads of Normandy 11,000 men. During those same ten days we lost 26,000 civilians, killed and wounded, on the highways and in the industry of this country, and those were the days of gas rationing!

The same accidental losses still occur every day. There is no real fuss about them, no excitement. But if on a Saturday night in some community an ambulance screamed to the door of a hospital and, instead of four victims of an automobile accident, there were four cases of plague or typhoid fever or any one of the exotic diseases that we fear, the whole state and the adjacent states would be in general alarm for days, and everybody would want something done about stopping this epidemic.

I think that we have come to take this accident problem as a matter of course—an unpreventable problem because we don't have a vaccine or a serum or medicine or something specific that we can give to stop it. We do have engineering tools and psychiatric tools and social tools with which to work, but we haven't learned to use them together. Nevertheless, I think that we have enough knowledge in our hands to attack this problem properly, and we in medicine should

take a certain amount of leadership in this attack. We can make substantial progress even with our present knowledge, although I certainly agree with Drs. Hilleboe and Shepard that we need more and continuing research.

We must also encourage and assist in educational programs attacking the problem. In this connection one of the questions that needs to be considered is this: "What does an automobile do to the average individual to change his whole concept of manners?" It is a question that has to be considered at home, at meetings of parent teacher associations, and by other groups, as well as in driver education classes in school. With regard to the latter it might be well for the parents of the students to sit in occasionally because it doesn't do much good to teach the proprieties to our youngsters and then have them violated by the example set when they are riding with their parents.

When it comes to learning by example, there may be much to be gained from the driving record of disabled people. We see in the Institute now between 300 and 400 paraplegics and quadraplegics each year. We have a number of quadraplegics who are driving with no triceps, with only partial fingers left, but with certain changes in their car and a glove that keeps their hand to the wheel. They seem to make excellent drivers. We have a paraplegic girl, now in her eighth year of driving, who thinks nothing of getting in a car and driving down to her home in North Carolina and back. In riding with her, I am amazed at her skill and care and sensitivity in driving.

Perhaps one reason that disabled people have such a sensitivity is that they recognize driving as a great privilege. They have lost the power of basic locomotion, but to be given the privileges of locomotion in this way makes them appreciate the opportunity. This shows up in their safety record. For example, Abilities, Incorporated, which hires only severely disabled people (polio cases, blind and deaf, cardiacs, hemiplegics, and paraplegics) had this safety and attendance record in 1955, as compared to national norms:

Days absent per 100 scheduled working days: 0.021, normal 3.3.

Days paid sick leave: 0.019, normal 1.3.

Average days lost per injury per 100 scheduled working days: 0.033, normal 0.13.

Days of disability per injury: 1.8, normal 14.3.

This suggests what can be accomplished through proper preventive measures. It also makes us wonder whether it might not be well worth while to employ some of the disabled as driving instructors and examiners who could teach both by precept and example, impressing many by their sensitivity and sound judgment.

Today accidents rank high as the cause of death and injury among all age groups. The head of a large western clinic recently indicated that they did not have a single death in their entire pediatric practice during the preceding year; those that came to their attention resulted from home and traffic accidents. This is a problem that the medical profession alone cannot solve. However, the doctor can be the prime educator in the accident prevention program. If he is given the proper material and if he is willing to carry the message to individuals and to groups, we can make real progress, educationally speaking. The physician must also do what he can to help identify those who are unfit to drive. He can also contribute a great deal to research in accident prevention. Of course, this is not his problem alone, and so it is most heartening that this symposium has brought together representatives of different disciplines and different interests to discuss this great common problem. Only through such teamwork can we come to sound and practical solutions.

Human Factors in Accidents

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THE one thing heard most frequently in this symposium has been our lack of knowledge concerning safety. This is especially true of the human factors involved. It is indeed a basic difficulty. Our nonmedical colleagues sometimes tend to believe that the examining physician has some magic for identifying and remedying the numerous human factors involved in accidents. Performance characteristics can readily be drawn up for machines but not so easily for men.

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We know far too little about variations in human performance both in health and disease; indeed, even the demarcation between health and disease is often blurred.

At today's conference some progress was made in delineating medical conditions that are meaningful in relation to driving performance. Fairly precise measures can be made in some areas of human function, notably in the special senses of the eye and the ear. However, most areas of human function are not yet susceptible to precise measure, at least by present-day methods.

A great amount of basic research is a necessity of the first order if we are to learn more about humans as drivers of 2-ton machines. Sound and effective administrative and educational programs depend on such research being carried out.

For present purposes an accident may be defined as an event that culminates a series of events and which in varying degrees is unlooked for and unpleasant. If an event is described as unpleasant, it must somehow involve a human being, and by definition, therefore, no accident is without so-called "human factors." A difficulty arises, however, when we attempt to isolate or define what we mean by "human factors" in an accident. To us the justification for using the phrase is that it serves to emphasize the great importance of individual and group behavior in the production of accidents. The concept is weakened if it leads to the dichotomy of "human factors" versus "nonhuman" factors. By and large such a division has little meaning.

The schema which we are about to present is only one of many that might be devised. We might add parenthetically that any schema is only as good as the fruitful communication it promotes among investigators and, of course, the validated accomplishment that results from its use.

The four categories of human factors, each of which I shall discuss briefly in turn, are physical, psychologic, social, and cultural. The first pair—physical and psychologic—involve mainly individuals. The second pair—social and cultural—involve mainly groups, both large and small.

Individual physical differences are generally quite obvious. The agile three-year-old, the strapping young male, the presbyopic oldster—all have physical characteristics that carry different types of accident potential. Comparisons may be made on many bases: age and sex variations, variations under physical stress, variations determined by organic impairment or drugs or climate. The list is virtually endless, and it will take all the ingenuity of many investigators to choose the right leads and to come up with applicable answers.

What of psychologic—or emotional or personal—characteristics? Regretfully, we must lay to rest any oversimplified concept of the accident-prone individual and, indeed, mix hope with skepticism that the more neutral term of "accident-repeater" will lead to usable conclusions. This does not imply that the accident-prone individual does not exist. He probably does. Unfortunately, however, we have not been able to isolate him with any consistency. Neither are there usable yardsticks of accident-proneness nor measures of the degree of stability of this quality. Accidents have the characteristics of being relatively infrequent phenomena; of being determined by multiple, not single, factors and in the main determined by more than one person—all this in a constantly shifting environment. The fact is that accident-proneness has not hurdled the barriers that these characteristics symbolize.

This should not suggest that the investigation of transient and permanent emotional patterns is not warranted. There is wide agreement among psychiatrists that *Homo sapiens* comes equipped with aggressive drives, mostly benign—indeed helpful—but also frequently destructive to the individual and those around him. To understand both the healthy and the malignant emotional patterns, how they operate, in whom, when, and to incorporate the findings within a logical over-all theory of accident phenomena will be a great accomplishment indeed. It is hardly necessary to add that such an accomplishment will not come about overnight. The answers, as most of the answers involving human behavior, will come slowly and piecemeal.

Now to the third category—that of social factors. There can be found in human society a great many identifiable groups. We may define a group simply and broadly as being made up of people who have something in common. Particular groups may have homogeneous or heterogeneous memberships; individual roles and status may vary; in many groups the individual has superiors, peers, and subordinates. This concept of the societal group has importance in

accident research because intergroup and intragroup relations undoubtedly affect the frequency and type of accidents. For example, what of the position of the adolescent in our society and the accidents he incurs? Likewise, what of the group of sixty-five years of age and older? What societal characteristics of the American family have relevance to accidents within and without the home?

Last, we come to the influence of our culture. Not only is a man a social animal, he is a culture-bearing animal as well. He shapes and is shaped by his institutions, customs, beliefs, and attitudes. Here is an almost entirely unexplored field for accident investigation. Two examples: Can the American's attitude toward his automobile be modified in such a way as to reduce the accident toll on the road? What part does the contemporary male's mode of expressing his masculinity play in the production of home accidents?

These are suggestive and illustrative only. Such questions should be advanced, worked over, and refined; then research should be set up to secure meaningful answers.

Before closing it seems appropriate to say a few words on the very human subject of safety education. It seems to us that educational measures should be based on up-to-date learning theory, which is to say that the psychology of the individual and the psychology of the group should be taken into consideration at every turn. What motivates the individual? How is group behavior modified, and how permanent are the effects that can be achieved? Do scare tactics work and, if so, for how long? What is the role of preaching, imploring, and enforcing?

We realize that we are asking no more and no less than the following questions: What makes human beings tick? Why do they behave the way they do? Indeed, we have come to the conclusion that those who are in accident research must face questions as large as this. We can assure them that the search for answers will be as exciting as any in the entire world of scientific endeavor.

The Conclusions and Recommendations of the Conference Workshop Groups

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(Commissioner of Health, State of New York)

ONE of the speakers at the symposium very aptly said that the important accomplishment of this meeting was the presentation of ideas for subsequent testing and proving. The symposium served, therefore, as a sounding board.

The subject is so complex that it is not possible to provide all the substantiating data in one day or to present all the material that is available. What we did have was the opinion of many experts and some recommendations that need to be tested by further research.

The main points made by the three groups—Psychiatric-Psychologic, Organic Medical, and Drug and Chemical—could be collected under five headings: general opinions, specific information, educational factors, suggested action, and the need for research. The details of the recommendations of each section, however, are not contained in this brief summary since they may be found in the sectional reports.

One of the objectives of this symposium was to review the present knowledge concerning medical and psychologic factors in traffic accident causation. A second objective was to consider the knowledge and the opinions of medical specialists in relation to driver licensing, with particular reference to establishment of physical and mental standards for motor vehicle operators.

With these objectives in mind, it was agreed that no single screening method could be used in determining human behavior characteristics relating to automobile accidents. Unfortunately, there has been a tendency on the part of many people to use laboratory technics or single devices, which can be applied to an individual or to groups of individuals in a short period of time at little cost, to determine whether a person should be allowed to drive.

Yet, it was also suggested that an eye test be given at each renewal application for the driver's

license. In addition to the fact that this only treats a small segment of the problem, the magnitude of the operation would not make such a recommendation feasible. Commissioner Joseph Kelly of the New York State Bureau of Motor Vehicles emphasized this by pointing out that there are 4,800,000 persons with licenses in New York State.

We must be very careful in dealing with isolated disabilities. For instance, it was brought out that there is some evidence that deaf mutes, on the basis of miles driven in a particular state in recent years, actually had better accident experience than a similar group of people who were not deaf or mute. Care must be used to guard against penalizing some people too severely simply because they have disabilities. This point was raised too when restrictions were suggested for sufferers of various forms of heart disease and other organic diseases and for the aged. Although we are attempting to protect the public by restrictive measures, we should also be concerned with the protection of the rights of disabled individuals.

In line with this thinking a recommendation was made that individuals involved in accidents should have their licenses suspended pending special and physical examination before their licenses are renewed. This recommendation also suggested examinations be given at the time a license is renewed. Again, Commissioner Kelly cited the 4,800,000 drivers in New York State to stress the magnitude of the problem. Under present conditions with the funds and facilities available, examinations of all applicants for new licenses and renewals would be an impossible task.

A similar recommendation, however, might prove practical and an aid in research. It was suggested that for a reasonable amount of funds more adequate records could be kept on those individuals involved in accidents. With these records competent investigators could do research which could be fruitful. This recommendation could be put into effect in many places with very little change in present administrative practices.

It is important, however, when doing research, that proper groups be used for comparison and more exact interpretation. For instance, we cannot take a sample of hospital patients and draw conclusions which are typical of the population as a whole. Therefore, we cannot do research simply on those who have accidents. We must compare them with those who have not had accidents. We need this comparison for a clear understanding of the problem.

When we fully analyze this subject of research, we must agree that there just is not enough money being spent in this field. It was pointed out that of the hundreds of millions of dollars being spent for road building, only 2 per cent was being spent for road research. And, to take this one step further, only a small portion of that 2 per cent was being spent for medical research. The members of the symposium were cognizant of this lack of enough money for medical research in motor vehicle accident problems and were of the opinion that the government should gather together representatives of engineering, medicine, and licensing agencies with enough funds to accumulate and to analyze meaningful data. It certainly is a realistic proposal and one which merits consideration.

As one more step in this direction, it would seem that instead of the testing centers now run by nonprofessional people in many states, centers conducted by a group of specialists in the various fields of medicine combined with social scientists and biostatisticians would be more effective. The motor vehicle bureaus, health departments, local medical societies, and medical schools could combine to determine the proper organization of such centers. The problems are so complex that no one group can supply all the answers.

Motor vehicle agencies must begin to spend more money to buy not only consultation services for individual cases but also expert advice on setting up standards for licensing. These services can be obtained from the medical schools, schools of public health, and medical societies. Among other sources is the health department, which invariably has personnel who are skilled in epidemiologic research and with whom the motor vehicle agencies can work. In New York State, for instance, the Health Department and the Bureau of Motor Vehicles are combining resources on several projects not only to determine driving habits of individuals, but also to set up a center where those drivers who have had accidents and new applicants for licenses can be examined and interviewed.

One recommendation of the symposium touched on this phase of the problem. It stipulated that a network of the American

Association of Motor Vehicle Administrators, the Interstate Commerce Commission, and other related groups in cooperation with the medical advisory groups of our national, state, and local medical societies accept the responsibility of stimulating research and establishing standards which are to be used for licensing of individuals. Research stimulated by such a group would be meaningful, for the findings could be readily tested for reliability and validity within the limits of cost, results, and acceptability to the people who must support these tests and to the people who must undergo these tests.

This last point is important for it brings us to the third objective of this symposium—to present facts and opinions to the general practitioner and others interested in traffic safety. A recommendation was offered to create additional informational services for the medical profession and the public. Granted that this recommendation has merit, it would seem that information directed towards physicians should be provided through postgraduate courses. This would be more acceptable to the physician and more fruitful. Many state health departments and medical societies offer postgraduate courses. There is no reason why the subject of automobile safety could not be included.

With the advent of the era of miracle drugs we face an additional problem in traffic safety. Many times, ordinary dosages of these drugs will affect temporarily but adversely the driving ability of the patient. The physician who is informed of this can do a valuable service to his patient by telling him of the possible effects the drugs may have on his driving skills.

Perhaps, in a more indirect manner the physician can assist in another, more complex problem. This is the influence of alcohol in automobile accidents. It was pointed out that one research project, with the use of 900 postmortems, found samples of alcohol in the brain and blood in approximately 50 per cent of these accident deaths. Certainly, a physician who knows the background of the patient can do some individual education on this point.

The education of the general driving public is an important part of traffic accident prevention. It is a complex task and one which will tax the resources of every group concerned with traffic safety. There is one important thing which all these groups must remember. All their research will be of no avail if the public cannot understand the results. The findings of these research projects must be expressed in simple, ordinary terms so that the general driving public can understand them, accept the findings, and do something about reducing traffic accidents.

The highway men of olden days were novices compared to the reckless drivers of today who pounce upon the unwary and rob him of his health and, too often, of his life. Government has a responsibility and private groups a great opportunity to support fundamental research into the human aspects of traffic accidents. New scientific knowledge can help us to rescue dangerous drivers from their own careless and destructive actions.

Physicians and Automobile Accidents

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PHYSICIANS, like other troubled citizens, must ponder in growing awe and fear the appalling death rate from motor vehicle accidents. But they, even more than other citizens, must play a key role in reducing this preventable form of mortality, for they are vitally concerned with the many more thousands who are injured, maimed, and often disabled as survivors of accidents.

Physicians ride the highways daily, and few groups exceed them in the frequency of use of motor vehicles. Therefore, they know at first hand that physiologic and psychologic factors determine the fitness of drivers, their reflex movements, the adequacy of their training, and, perhaps most important, their awareness of their own health limitations, including factors relating to mental health.

We, as medical men who are taught and teach our patients the value of preventive medicine, cannot deny the imperative need to help state licensing authorities set up tests of qualification for all drivers. Under modern road conditions with higher tolerated speeds on many highways drivers operate vehicles with a lethal potential that is growing ever greater. At high speeds the responsiveness of the operator to sudden dangerous situations determines whether or not an accident will occur. May it not be timely for us to designate the automobile a dangerous vehicle just as certain weapons are classified as dangerous?

Readers of the reports of the workshops held during this symposium may be surprised at the diversity of opinion on many specific questions of health. For example, participants in one of the workshops hesitated to apply strict requirements for driver fitness related to age on the ground that insufficient data exist to adopt a strict rule. However, most insurance companies will not insure persons over sixty-five against accident, health, or life. If the risk is too great for the insurance companies because of the manifest decline in health and increase in morbidity related to age, is it wise for the state licensing authorities to permit persons over sixty-five to operate dangerous vehicles without requiring periodic certificates of health, including road tests at high speeds? Should the period not be short enough to anticipate or make possible the early detection of changes in body function which might influence driver fitness? Would it not be desirable to require an annual certificate of persons over sixty-five? Many may object to a mandatory examination, but how else is the rest of the driving public to be protected from the weaknesses or faults of drivers whose fitness is not what it used to be or is not equal to the demands of new driver conditions? Must we wait until more accidents precipitate more deaths?

There are many controversial aspects to the problems that nonhealthy drivers present. Most physicians, aware that diabetics taking insulin must be cautioned about insulin-induced reactions, probably caution their patients about the need for care in the operation of a motor vehicle if they are sensitive to insulin or irregular in their responsiveness to it. Licensing authorities need assistance in evaluating such subjects. Dr. Joslin in Boston has been instrumental in influencing the Bureau of Motor Vehicles in Massachusetts to adopt a reasonable attitude concerning the issuance of licenses to known diabetics. He has pointed out that carefully instructed diabetic subjects, aware of their special state, are proving to be safer drivers than many so-called normal subjects. Similarly, Dr. William G. Lennox has argued urgently and favorably for a liberal treatment of the epileptic who has been free of seizure for a long enough period, provided he is under strict control. In the hypertensive subject the problems are especially difficult in evaluating driver fitness. It is one thing to permit him to drive his own vehicle provided he has no vascular complications, but it is manifestly not in the interest of public safety to risk permitting him to operate a passenger vehicle, nor is it in his own interest to permit him to drive any vehicle as his principal occupation.

The role of alcohol in accidents may be subtle or obvious. Hard and fixed rules like those prevailing in Sweden, where licenses are revoked permanently if a driver involved in an accident is found to be under the influence of alcohol, might be a necessary solution to the problem of curbing persons who do not realize that "alcohol and gasoline do not mix." In these days of free access to alcoholic beverages it would seem imperative to determine whether any quantity of alcohol in the blood of an adequate sample of drivers is compatible with safe driving.

In this connection it is interesting to note the experience of Nassau County, New York, in which (according to Dr. T. J. Curphey, Chief Medical Examiner) nearly 52 per cent of 269 drivers killed in automobile accidents were found to have brain alcohol in excess of 0.1 per cent (0.1 cc. per 100 Gm. of brain tissue), generally considered an excessive concentration. It would seem desirable then for comparative purposes to determine the quantity of alcohol in a random sample of drivers, taking into account the gradient relationship between blood and brain alcohol. As yet there are no substantial data on the basis of which one can determine whether or not a given level of blood alcohol or brain alcohol bears a definite relationship to driver fitness. Incidentally, there is hardly need to note the probable higher incidence of alcoholic "intoxication" on weekends and holidays and at night.

In addition to the need for warning drivers about alcohol, physicians must educate the

public about other drugs. Free access to sedatives and hypnotics creates another source of danger to automobile drivers. The medical profession may have to add to its many burdens the duty of informing and warning patients about hangover effects induced by various drugs of this sort. Most physicians are aware that the antihistamines may cause drowsiness, and in hay fever season they should warn their allergic patients who depend on antihistaminic drugs about the effects on the cerebral cortex and possible effect on their driving. The new vogue in the wide use of tranquilizing drugs, antipressor drugs, and their counterparts, the stimulants, especially amphetamine compounds, has added another set of sources for driver unfitness. Persons determined to travel great distances and driving for excessively long periods have learned that some stimulant may help. But are they always safe? How long is it safe to drive without stimulants? What are the effects of stimulants on drivers who have been at the wheel for six, eight, ten, or more hours?

What of other physical states and functions and their effects on driver fitness? Only medical evaluation can determine whether or not a driver may be licensed who has a disorder of bodily function. The workshops on visual standards and otolaryngologic aspects of motor vehicle accident prevention found it easy to set up certain arbitrary standards concerning visual acuity and sound perception. The group concerned with orthopedic aspects had relatively little controversy over the setting up of criteria for free bodily movements and the use of extremities. But it is manifestly unreasonable to generalize about the effects of various bodily disorders on all drivers. The paraplegic, specially trained and provided with a specially equipped vehicle, may excel all "normal drivers" in safety records.

The workshop on neurologic aspects had considerable difficulty in setting up criteria for certain types of individuals with neurologic disorders. The individual with epileptiform seizures has been in the limelight of the discussions concerning the responsibility of the licensing authorities in determining his fitness to drive. Recognizing the lethal dangers in motor vehicle operation, some would bar epileptics from driving unless they are free of convulsions and certified to be under rigid control for at least five years. Others, take a more liberal view along the lines expressed by Dr. Lennox.

Psychologic and psychiatric aspects of driver operation represent an area of considerable importance and controversy. The emotional stability of the driver with a powerful 2-ton passenger vehicle or 10-ton trailer truck, with a momentum of terrific force at speeds of 40 to 70 miles per hour, is as important as any single factor in maintaining traffic safety. The stakes in human life and suffering are greater on the highways because the damage done by the neurotic, irresponsible driver is so devastating. In the face of the dangers, how can responsible automobile manufacturers tempt the users of new vehicles with invitations to "step on it and go?" Why does the advertising profession tempt the driver with billboard posters, television pictures, and other advertising examples of speed on the highways? How, in good conscience, can all of us ask for safety and moderation and sensible driving when speed records are made newsworthy, when the amount of horsepower is equated with dynamic achievement? The juvenile driver under the forces of growth, with an expanding ego and broadening social horizon, demands and usually obtains free access to motor vehicle transportation; he is in a hurry, impatient, burning his candle brightly and rapidly, and enjoying the feeling of power and freedom of movement. He is often unaware of the status of other drivers and the wisdom of heeding signs of danger or speed restriction. He is not mature enough to be especially concerned with the rights of others or with their limitations. To educate him in safe operation of a motor vehicle is a social and public health problem of tremendous magnitude. He has the quick reflexes, the responsiveness, that make him a nervy and often reckless driver who may squeeze through dangerous situations by a hair's breadth. But statistics bear tragic witness to the performance in this juvenile group.

Unfortunately, emotional stability is not always attained with passing time, and there are plenty of adults who, sensing the force of 250 horsepower at the tips of their toes, act with the same reckless abandon. The nervous tension of any driver at any age is a factor that he alone must evaluate in determining the mode in which he operates his vehicle and whether or not he can protect himself as well as others from possible accidents. The psychiatric and psychologic

workshop dealt with these problems and delineated for the thoughtful student of this subject a good deal that needs to be done in measuring the role of psychologic and psychiatric factors in driver fitness.

Perhaps more difficult to define is the matter of applying criteria to commercial vehicle operators as compared with private car operators. Employers of commercial and public vehicle operators have become sensitive to the problem of motor accidents because they are deeply involved in legal, economic, and licensing responsibilities. Casualty insurance companies and compensation agencies have an enormous stake in the safe operation of vehicles by such drivers. Readers are referred to recent favorable experience with the application of some criteria to the choice of such drivers. In New York City a large surface transportation system has been able to reduce its accident rate by 50 per cent since the introduction of improved medical selection of drivers and related safety measures.[1]

Here, as with the general public, much care must be exercised in the application of criteria. The seasoned truck driver with hypertension of 220/110 mm. Hg may be a much better driver than a young, inexperienced, normotensive man, but is the risk of vascular accident great enough to disqualify the older man? The cardiovascular group disagreed about the application of level of blood pressure to the selection of motor vehicle drivers. There can be little argument that passenger vehicle drivers (bus drivers) should meet health standards no less rigid than the Army and Navy now requires for servicemen, and hypertension is a bar to admission to the armed forces. The lives of passengers will not brook medical indecision. Employers for their part should be prepared to provide alternative occupations for veteran drivers whose health category changes from safe to one of risk requiring relief from duty.

Similar questions can be asked about many medical disorders that have various effects on driver fitness. In an area where life, death, or crippling injury is contingent on the human factors determining driver fitness, it is urgent that the medical profession recognize the need for systematic investigation of the various disorders of mind or body that may be disqualifying for automobile operation.

While present knowledge is inadequate, public health authorities, the state licensing authorities, and the medical profession should systematically warn disabled persons about the risks of driving. The physician must warn his convalescent or chronically ill patient who is about to resume driving. One wonders whether or not certain categories of illness might be made reportable to the insurance companies before they renew accident insurance policies. Should not the commissioner of motor vehicles inquire every year instead of at longer intervals, concerning the fitness of reregistrants for drivers' licenses? Should persons over a given age be required to pass tests of hearing, vision, reflex responsiveness, and to provide certificates of good health annually? If involved in accidents, should not such persons be required to take driving tests before reissuance of license? In this connection note the recommendation by the general medicine workshop that an individual involved in a police-investigated accident should have his license suspended and not renewed until the commissioner of motor vehicles considers that the individual's physical and mental status is satisfactory to operate a motor vehicle.

The casualty insurance companies, with their economic stake in safe driving, have a great potential role in promoting programs to improve driver fitness and to demand better evaluation of driver health in order to reduce automobile accidents.

These are matters arising from contemplation of the many problems confronting the workshops that met to consider medical aspects of safety in motor vehicle operation. Readers are referred to the excellent summary of Doctor Herman E. Hilleboe at the close of the symposium, showing that much was considered, and a great deal more remains to be done before reasonable safety in motor vehicle operation is attained in our society.

Reference

1. Brandaleone, H., and Friedman, G. J.: Medical Care in a Surface Transportation Company. Indust. Med. & Surg. 21 : 174 (Apr.) 1952.

Recommendations for Research Consolidated from the Symposium Proceedings

Throughout the symposium there was frequent recognition of the need for definitive, scientific investigation relating to the various medical aspects of motor vehicle accident prevention. Although it was not possible to note all of the research needs mentioned from time to time in the several discussion groups, the formal reports of these groups contained a number of important recommendations which are herewith itemized:

1. More adequate accident records need to be devised to provide significant information for research purposes.

2. The characteristics of accident-involved drivers need to be more carefully compared with those of accident-free drivers.

3. The driving habits and attitudes of new applicants for the license to drive should be analyzed through examination and interview.

4. Studies should be undertaken of the duration and extent of disability in various psychiatric and neurologic diseases.

5. Psychiatric-psychologic research centers should be set up to develop technics that would assist licensing authorities in the assessment of the mental and emotional fitness of driver license applicants.

6. There is need for comprehensive data, based on exposure and risk of the effects of organic disease and the aging process on the motor vehicle accident rate. Among the important variables that need to be controlled in such research are alcoholism, mechanical difficulties, and road conditions.

7. Studies should be made to determine specific organic disabilities that limit the ability of individuals to drive safely. The American Association of Motor Vehicle Administrators, the Interstate Commerce Commission, and other interested groups might combine to support such research.

8. There is need for adequate collection of medical data in accident cases in order to determine the relationship of physical condition to accident causation.

9. The traffic safety records of cardiac patients should be compared with those of noncardiac individuals and evaluation made of all data related to specific cardiac defects.

10. Research should be undertaken to establish the role of depth perception, muscle balance, and visual and perceptual reaction time in the causation of motor vehicle accidents.

11. A study should be made, possibly by the Veterans Administration, of the driving record of veterans who are amputees or have other orthopedic disabilities and operate automobiles with special equipment. Collection of data would be facilitated if state licensing authorities maintained separate files for all drivers using special controls on motor vehicles.

12. Studies are needed to relate objective measures of driver performance to levels of alcohol in the body, comparisons to be made of individuals involved in accidents, individuals apprehended for traffic violations only, and a third or control group of drivers involved in neither accidents nor violations.

13. A comparative study should be made of the driving performance of individuals who drink alcohol and those who do not.

14. Chemical and pharmacologic research is needed to determine whether metabolic products other than alcohol impair the driving ability of individuals who have consumed alcohol.

15. Federal, state, and private agencies should combine forces to support research on the pharmacologic effects of commonly used drugs, including stimulants,

sedatives, antihistamines, antihypertensives, and tranquilizers, as they relate to or influence driving behavior.

These recommendations are only suggestive of the many needs for research in this field. There is already a substantial body of knowledge on the subject. But, comparatively speaking, this constitutes merely the first chapter of a volume that remains to be written by medical and allied professions.

Appendix

Reference Materials Made Available in Advance to Symposium Participants

1. American Optical Company: 1956 Survey of State Requirements for Motor Vehicle Operators, Southbridge, Massachusetts, American Optical Company, 1956.

2. Brandaleone, H., and Friedman, G. J.: Physical Standards for Vehicle Operators. Indust. Med. & Surg. 25: 17 (Jan.) 1956.

3. Brody, L.: The Man Behind the Wheel. Public Safety, June, July, 1954.

4. Center for Safety Education, New York University: Medical Literature on Accidents and Accident Prevention: A Bibliography, New York, Center for Safety Education, 1955.

5. McFarland, R. A., Moore, R. C., and Warren, A. B.: Human Variables in Motor Vehicle Accidents: A Review of the Literature, Boston, Harvard School of Public Health, 1955.

6. National Conference on Street and Highway Safety: Uniform Vehicle Code (Section 6-103: What persons shall not be licensed; section 6-110: Examination of applicants), Washington, D.C., U.S. Government Printing Office, 1945.

7. Report of Committee on Standards for Motor Vehicle Operators, Apr., 1956: Reference List of Conditions Which May be Non-acceptable for Driving. Indust. Med. & Surg. In press.

*Extract from Uniform Vehicle Code**

SEC. 6-103—WHAT PERSONS SHALL NOT BE LICENSED

The department shall not issue any license hereunder:

4. To any person, as an operator or chauffeur, who is an habitual drunkard, or is an habitual user of narcotic drugs, or is an habitual user of any other drug to a degree which renders him incapable of safely driving a motor vehicle;

5. To any person, as an operator or chauffeur, who has previously been adjudged to be afflicted with or suffering from any mental disability or disease and who has not at the time of application been restored to competency by the methods provided by law;

8. To any person when the commissioner has good cause to believe that such person by reason of physical or mental disability would not be able to operate a motor vehicle with safety upon the highways.

Alternate 8. To any person when the commissioner has good cause to believe that the operation of a motor vehicle on the highways by such person would be inimical to public safety or welfare.

SEC. 6-110—EXAMINATION OF APPLICANTS

(a) The department shall examine every applicant for an operator's or chauffeur's license, except as otherwise provided in this section. Such examination shall include a test of the applicant's eyesight, his ability to read and understand highway signs regulating, warning and directing traffic, his knowledge of the traffic laws of this State, and shall include an actual demonstration of ability to exercise ordinary and reasonable control in the operation of a motor vehicle.

* National Committee on Uniform Traffic Laws and Ordinances, Washington, D.C., 1954.

1956 SURVEY OF STATE REQUIREMENTS FOR MOTOR VEHICLE OPERATORS

Operators of Private Cars

(Not Chauffeurs)

COMPILED BY AMERICAN OPTICAL COMPANY

		ALA.	ARIZ.	ARK.	CAL.	COLO.	CONN.	DEL.	D. C.	FLA.	GA.	IDA.	ILL.	IND.	IOWA	KANS.	KY.	LA.	ME.	MD.	MASS.	MICH.	MINN.	MISS.	MO.	MONT.	NEB.	NEV.	N. H.	N. J.	N. M.	N. Y.	N. C.	N. D.	OHIO	OKLA.	ORE.	PA.	R. I.	S. C.	S. D.	TENN.	TEX.	UTAH	VT.	VA.	WASH.	W. VA.	WISC.	WYO.	ALASKA	HAWAII
LICENSE:	Minimum age — yrs./mos.	16	16	16	16	16	16	16	16	16	16	16	16	16/-	16	16	16	15	15	16	16	16	15	15	16	15	20	16	16	17	18	16	16	16	16	16	16	16	14	15	16	14	16	16	15	16	16	16	16	15	16	15
	Cost of license	$2.25	$2	$1	$3	$2	$6	$4	$3	$1	$1	$2	$1	$1	$1	$1	$2	$2	$2	$3	$5	$3	$2	$2	$1	$3	$2	$2	$4	$3	$1	$5	$2	$2	75¢	$4	$1	$4	$2	$2	$2	$2	$2	$2	$3	$1	$2	$1	$3	$2	$3
	Duration in years	2	3	1	4	3	2	2	3	1	2	2	3	2	2	2	2	2	1	M	2	3	4	2	3	2	2	2	2	3	1	2	3	4	2	3	2	2	1	2	4	2	2	2	3	1	3	2	4	4	3	2	M
	Restricted or Instruction permit at age – yrs./mos.	16	16/-	14	14	16		16	16	14	15	14	14	16	14	16	14	16	15	15	16		14	15	15	16	16	14	15	16	15	16	16	13	16	15/-	15	16	16	13/-	13	16	14	15/-			15	16	16	14	15	14	15
DISQUALIFIED:	Mentally or physically unfit	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Drug addict or habitual drunkard	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Improper Person – Bad Behavior Record	•	•		•		•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•		•	•		•	•		•	•		•		•	•			•	•	•	•	•	•
EXAMINATION:	Required for new drivers	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Fee for examination		$2				$2												$1		$3	$3							$1	$1		$2	$2											$2	$2		$2						
	Signs, laws, driving ability	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Minimum visual acuity — without glasses 2 eyes	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40
	— 1 blind eye	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40
	— with glasses 2 eyes	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40
	— 1 blind eye	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40
	Depth perception		•				•	•										•					•	•		•	•								•	•																	•
	Color blindness	•	•	•		•	•	•	•					•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•		•		•	•	•	•				•	•	•	•	•	•	•	•		•
	Visual field						170°	180												140°	120				150	140	140		170								180										180					
	Hearing standards	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Psychophysical test (reaction, eye-foot)																																•																		
LIMITED LICENSE:	Wearing glasses	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Mirrors	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Daytime only	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Periodic vision test	•	•		•	•	•	•		•	•	•	•	70		•	•	•	•		•		•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•													
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	Hearing device		•		•		•			•	•		•			•					•		•	•		•	•		•	•	•	•	•	•	•	•	•	•		•											
	Height (raised seat, etc.)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Special mechanical devices	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Type vehicle (automatic clutch, etc.)	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
RE-EXAMINATION:	For renewal — on or before expiration			VI.			VI.	V.						V5I.			V.						V.									V5I.															V.				
	— after certain age																																																			
	— if physical limitation		•		•	•		•			•	•			•				•	•					•	•			•																							
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	After suspension					•	•	•	•	•			•	•		•								•				•	•																					
	After revocation	•	•		•	•	•	•	•	•			•	•		•								•				•	•																					
	Accident repeaters		•		•	•	•	•	•	•				•		•								•				•	•																					

LEGEND: • standard practice governing all licenses; IND. individual

V vision test; VI. vision and letter test; V5I. vision, signs, hand test

THE ABOVE DATA TAKEN FROM STATISTICS REGULATIONS AND PROCEDURES AND VERIFIED BY EACH STATE MOTOR VEHICLE ADMINISTRATION
CONSULT STATE LAW FOR MORE DETAILED PROCEDURES

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Dr. McFARLAND. Thank you very much, Dr. Brandaleone.

I happen to know that Dr. Brandaleone has practiced what he has been preaching. He has, through very careful physical examination of drivers, materially improved the accident experience of several large transport companies.

I think, in this medical area, it is well to point out that we need to know more about the cutoff points in various disease categories; that is, heart disease, epilepsy, and diabetes. When should a person be deprived of a license? This cannot be done, in my opinion, by subjective reporting, but must be done through basic research.

A great deal of this research is yet to be carried out. We have started with approximations, and we must now try to do the actual studies.

With Dr. Root at the Joslyn Clinic in Boston, Mass., we have just completed a preliminary study of a thousand diabetic drivers. It appears that 1 out of 3 of these persons taking insulin have been involved in an accident. This would appear to be an important area for further investigation.

Mr. ROBERTS. I believe Dr. Brandaleone offered certain attachments as exhibits to his statement. With no objection on the part of the members of the subcommittee, those will be admitted and placed in the record.

Dr. McFARLAND. I am next going to call on Mr. Abercrombie, of the national commission on safety education of the National Education Association.

STATEMENT OF STANLEY A. ABERCROMBIE, ASSISTANT SECRETARY, NATIONAL COMMISSION ON SAFETY EDUCATION OF THE NATIONAL EDUCATION ASSOCIATION, WASHINGTON, D. C.

Mr. ABERCROMBIE. Thank you, Dr. McFarland.

Congressman Roberts, members of the subcommittee, panel, and visitors, it is a pleasant privilege to come here this morning and bring you a few thoughts from the field of education.

The broad interest of educators in traffic-safety research is in those phases of such research that concern teaching and learning. Teachers want more facts about the relation of accident tendencies to human growth and development—facts that will help them motivate good learning, and help them change the learner's pattern of behavior.

Educational administrators want to know how to organize and administer instructional programs so as to effect more fruitful teaching, and, at the same time, to extend the benefits to many more students than is presently possible. Thus, educators see research in their field as a part of traffic-safety research, generally. Moreover, in the educational phases of traffic-safety research, educators need the assistance of psychologists, sociologists, and other scientists whose interests have a bearing on the behavior of drivers and pedestrians in relation to the traffic environment.

Although there were very few researches in safety education before the mid-1930's, the number of degree research studies in this field has increased markedly since 1938—not only at New York University, which established in that year the first specialized educational center for safety, but at other institutions, as well.

A number of local school systems and State education departments have made studies to determine the values of driver education in terms of traffic-law violations and accidents. Most of these studies were made since the end of World War II. In addition, a few local school systems have done research on the effectiveness of simulators used in driver education.

Among the educational researches in traffic safety now underway or recently completed, the following are, perhaps, representative. And I cite these five to give you an idea of the general spread of interest in educational research in traffic safety:

Teaching for attitude conducive to safe driving; the use of group discussion-decision method in USAF traffic-safety education; an evaluation of the teaching effectiveness of the multiple-car plan; recommended practices and procedures for the selection and education of school-bus drivers; and survey of personal and interpersonal factors in driving, which Dr. Gaskill mentioned earlier.

Under the auspices of the research advisory committee established by the National Education Association's commission on safety education, three reports have been published. They are: Research Needs in Traffic Safety Education, A Critical Analysis of Driver Education Research, and How Experienced Teachers Develop Good Traffic Citizens.

Mr. Chairman, I would like to offer these for the record as attachments to my statement.

Mr. ROBERTS. Without objection, they may be received.

(The documents referred to follow:)

What can you do?

RESEARCH NEEDS
In Traffic Safety Education

A questionnaire survey prepared by the NEA Research Division for the National Commission on Safety Education (NEA)

NATIONAL COMMISSION ON SAFETY EDUCATION
National Education Association
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I. INTRODUCTION

The NEA National Commission on Safety Education has instituted a cooperative research program to expand traffic safety education and to improve instructional methods. This report summarizes a survey of research needed in traffic safety education.

Some historical data are pertinent in order that the reader may understand the genesis of this document and its place in the Commission's broad program of traffic safety education research.

Early in 1955 the Commission assembled a committee of leading educational researchers and specialists in traffic safety to discuss the research needs of classroom teachers and to suggest how a program could be organized. The members of this committee were:

T. W. FORBES, *Program Director—Highway*, American Institute for Research, Pittsburgh, Pennsylvania

IRA SCOTT JOHNSON, JR., *Driver Education Teacher*, Ocean City High School, Ocean City, New Jersey

GERALD V. LANNHOLM, *Project Director*, Educational Testing Service, Princeton, New Jersey

A. R. LAUER, *Professor of Psychology and Director*, Industrial Science Research Institute, Iowa State College, Ames, Iowa

DONALD PATERSON, *Professor of Psychology*, University of Minnesota, Minneapolis, Minnesota

DUNCAN A. S. PIRIE, *Head, Exact Science Department*, Detroit Public Schools, Detroit, Michigan (project writer)

CLARA G. STRATEMEYER, *Supervisor of Elementary Schools*, Montgomery County Board of Education, Rockville, Maryland

M. R. TRABUE, *Dean, College of Education*, The Pennsylvania State University, University Park, Pennsylvania

J. WAYNE WRIGHTSTONE, *Director*, Bureau of Educational Research, Board of Education of the City of New York, Brooklyn, New York

From the proceedings of this meeting Duncan A. S. Pirie prepared a preliminary statement of the possible research studies in traffic safety education. The material was reviewed by the members of the committee, the staff and members of the Commission, and others. Upon completion of this statement of possible studies in traffic safety education, the committee concluded its activities.

In 1955 the Automotive Safety Foundation provided the first financial support for the cooperative program of safety education research.

Following the recommendations of the special committee and with the funds provided by the Automotive Safety Foundation, the Commission in cooperation with the NEA Research Division has instituted the following research projects:

1. *To stimulate research*, in May 1955 a list of possible research studies was arranged in questionnaire form and mailed to teachers of driver education, safety education supervisors, college teachers, and others thruout the United States. Those receiving the questionnaire were asked to rate the suggested studies according to their usefulness to classroom teachers. The summary of the replies to this questionnaire, presented in Part II of this report, is for use by educators who supervise research programs and by graduate students seeking suggestions for thesis topics.

2. *To promote the driver education program*, a second project was initiated to assemble and to analyze critically the studies which evaluate the accident and violation reduction values of driver education. The final report will evaluate the findings of studies, show their strengths and weaknesses, and serve as a guide to those who plan similar studies. Approximately 35 studies were identified and examined.

3. *To improve instruction*, a questionnaire survey was made of teaching technics used successfully by experienced teachers of driver education. These descriptions of teaching methods will be an invaluable aid to driver education teachers. If funds are available, the questionnaire survey will be supplemented and validated thru on-location interviews and obser-

vations of a selected group of outstanding driver education teachers.

In November 1955, the Research Advisory Committee was established. The purpose of this Committee is to give continuing guidance to the development of the Commission's broad program of traffic safety education research to improve instruction. The first meeting of this Committee was held immediately following the annual meeting of the Commission in January 1956. The members of the Research Advisory Committee are:

M. R. TRABUE, Chairman, *Dean*, College of Education, The Pennsylvania State University, University Park, Pennsylvania

HERBERT S. CONRAD, *Director*, Research and Statistical Services Branch, Office of Education, U. S. Department of Health, Education, and Welfare, Washington, D. C.

MAX R. GOODSON, *Assistant Dean*, College of Education, Ohio State University, Columbus, Ohio

IRA SCOTT JOHNSON, Jr., *Driver Education Teacher*, Ocean City High School, Ocean City, New Jersey

EDWARD LANE-RETICKER, *Assistant Director*, Institute of Government, University of North Carolina, Chapel Hill, North Carolina

J. H. MATHEWSON, *Assistant Director*, Institute of Transportation and Traffic Engineering, University of California, Los Angeles, California

E. B. NORTON, *President*, State Teachers College, Florence, Alabama

RALPH H. OJEMANN, *Professor*, Psychology and Parent Education, Child Welfare Research Station, State University of Iowa, Iowa City, Iowa

DEAN M. SCHWEICKHARD, *Commissioner of Education*, State Department of Education, St. Paul, Minnesota

CLARA G. STRATEMEYER, *Supervisor of Elementary Schools*, Montgomery County Board of Education, Rockville, Maryland

J. WAYNE WRIGHTSTONE, *Director of Educational Research*, Board of Education of the City of New York, Brooklyn, New York

The Research Advisory Committee reviewed the progress of the program. In regard to the research needed, the Committee considered the following areas most in need of research:

Survey study areas

1. Findings of studies of teaching technics and materials used in the driver education courses and in other areas of the elementary and secondary curriculums in terms of effectiveness of these technics and materials in improving the attitudes and behavior of drivers, passengers, and pedestrians.
2. Evaluations of the driver education program from comparisons of the driving records of course graduates with non-course graduates and from the judgments of police, judges, and motor vehicle administrators.
3. Types of motor vehicle accidents with particular reference to youth involvement as drivers and as pedestrians.

Experimental study areas

1. The development of information with predictive value to enable the teacher to determine an individual's probable accident involvement.
2. The measurement of the values of methods of instruction including the case study method, use of devices which simulate driving, and the like.
3. The validity and reliability of existing tests in driver education.

Among the important policy decisions made at the first meeting of the Research Advisory Committee were the following:

1. The need for funds to carry on the proposed and ongoing research projects is great. The policy of the Committee will be to demonstrate to potential grantors the value of the Commission's activities by completing at the earliest possible date some specific, effective studies.
2. The present report, listing and evaluating studies needed in traffic safety education, will be distributed widely to stimulate interest in research projects.
3. The Committee will encourage research workers to submit proposed project outlines for review and evaluation. Proposals will be submitted to the Commission and circulated to the members of the Committee. Each study will be judged on its own merits to determine if the proposed study will be eligible for financial support as funds become available.

The Committee is not a research body, but is potentially an extraordinary agent for influencing sound research. It is a unique organization whose leadership activities in this field may become exemplary for other areas of education.

II. FINDINGS OF A SURVEY OF RESEARCH NEEDS IN TRAFFIC SAFETY EDUCATION

In the fall of 1955, the National Commission on Safety Education asked the NEA Research Division to conduct an opinion survey to determine the major problems in traffic safety education. In response to this request, the Research Division polled a selected group of 2548 persons in the public schools, colleges and universities, and other interested agencies for their opinions on the relative values of suggested studies. This section summarizes the 944 returns received.

A. *General Procedure*

The National Commission on Safety Education selected the individuals to be included in this survey on the basis of known interest and work in the traffic safety field. The list of names included: (a) members of state driver education groups associated with the Commission; (b) safety educators from lists compiled by other sources; and (c) college and university personnel known to be actively engaged in traffic safety education.

All the states and the District of Columbia were represented. The geographical distribution of the questionnaire was similar to the distribution of the returns of the Research Division's 1953 survey of driver education in public high schools. This control was selected because it is a measure of regional interest in traffic safety education. Table 1 compares the distribution of the traffic safety questionnaire by region with the returns from high schools reporting driver education programs in 1952-53.

TABLE 1.—COMPARISON OF THE GEOGRAPHIC DISTRIBUTION OF THE QUESTIONNAIRES WITH THE HIGH SCHOOLS REPORTING DRIVER EDUCATION PROGRAMS IN 1952-53

Region [a]	Distribution of questionnaires	High schools reporting driver education programs in 1952-53 [b]
1	2	3
New England	5%	6%
Middle Atlantic	20	20
Southeast	14	11
Middle	31	33
Southwest	7	9
Northwest	10	11
Far West	13	8
Total	100%	100%

[a] *New England:* Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.
Middle Atlantic: Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia.
Southeast: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia.
Middle: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, Wisconsin.
Southwest: Arizona, New Mexico, Oklahoma, Texas.
Northwest: Colorado, Idaho, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah, Wyoming.
Far West: California, Nevada, Oregon, Washington.

[b] National Education Association, Research Division. "The Status of Driver Education in Public High Schools, 1952-53." *Research Bulletin* 32: 51-99; April 1954. (Computed from Table 1, p. 55).

Approximately 90 percent of the questionnaires went to state and local school personnel, including elementary- and secondary-school instructors of traffic safety; principals of elementary and secondary schools; supervisors, directors, and coordinators of safety programs; superintendents; and state education department supervisors. High-school driver education teachers were the majority of this group. The remaining 10 percent of the questionnaires went to colleges and universities, and to private organizations, such as insurance companies, automobile associations, and safety councils.

As of January 13, 1956, a total of 944 completed returns were received. This was a 37.0 percent return. Table 2 shows a breakdown of the returns by professional interest.

This report should be interpreted with the following limitations. It does not establish a definite policy for the NEA National Commission on Safety Education; it is presented as a guide to needed research. The studies were ranked by the composite judgment of a representative group of persons working in the field of traffic safety education, a majority of whom were teachers of driver education.

The suggested topics of research were not mutually exclusive; they differ internally in emphases and combinations of factors. Some were general; others were specific. They were designed to indicate areas of research. The specific statement of a problem was left to the research worker.

A survey and evaluation of the research which has been made on the topics listed was not within the scope of this report.

The survey and the experimental studies as rated by the 944 respondents are presented in Sections B and C. Because of their influence in directing research for advanced degrees in safety education, the views of college and university personnel are presented in Section D. Section E summarizes other topics of research suggested by the individuals polled in this survey. Section F summarizes research studies the respondents reported they would like to do. Section G is a brief summary of Part II.

B. *How All Respondents Ranked the Survey Studies*

In general, survey studies tell us about status and trends. They seek to find out how many or how much of a particular thing exists at a given time, to summarize conditions or opinions, or to compare the number today with the number at some time past. They are not experimental.

TABLE 2.—DISTRIBUTION OF RETURNS BY PROFESSIONAL INTEREST

Interest groups	Number of returns	Percent of total returns
1	2	3
School personnel		
Secondary-school teachers	695	73.6%
Safety supervisors and directors	48	5.1
Secondary-school principals and school superintendents	44	4.7
Elementary-school teachers and principals	19	2.0
State education department supervisors	18	1.9
Subtotal	824	87.3%
Colleges and universities	77	8.2%
Miscellaneous and unidentified	43	4.5
Total	944	100.0%

Thirty-six possible survey studies were listed in the questionnaire. The respondents were asked to rate each study as "very useful," "useful," or "of little or no value."

Table 3 shows the percent distribution among the assigned values, "very useful," "useful," and "of little or no value," for each of the survey topics. The rank of the topics was determined by their weighted scores. To arrive at a weighted score for each topic, the following procedure was used: (a) the total number of checks in the "very useful" column was multiplied by 5; (b) the total number of checks in the "useful" column was multiplied by 3; and (c) the total number of checks in the "of little or no value" column was multiplied by 1. The weighted score was the sum of the checks in the three columns multiplied by their assigned weights. Topics are ranked from high to low.

TABLE 3.—PERCENT DISTRIBUTION AMONG ASSIGNED VALUES FOR SURVEY STUDIES

Rank	Survey studies	Very useful	Useful	Of little or no value	No answer
1	2	3	4	5	6
1.	Number and kinds of accidents to students who have taken driver education as compared with similar age groups who have not had driver education	77.7%	20.2%	2.0%	0.1%
2.	Judgments of police, judges, and motor vehicle administrators on the strengths and weaknesses they have observed in driver education	71.6	23.4	3.8	1.2
3.	Findings of studies of how the attitudes and behavior of individuals change under specific kinds of driver instruction	65.6	29.3	3.6	1.5
4.	Judgments of classroom teachers and others as to the effective teaching technics which improve the behavior of pedestrians and drivers	62.3	31.3	5.1	1.3
5.	Findings of research with respect to the psychological and physical characteristics of individuals involved in accidents (including the equipment and environmental factors involved in the same accidents)	55.2	35.6	7.7	1.5
6.	Types of content material available for classes in traffic safety education, such as traffic control signs, inspection programs for bicycles and cars, and pedestrian safety	52.2	39.4	7.0	1.4
7.	Community resources used by teachers to enrich their instruction in driver education	51.3	40.8	6.5	1.4
8.	The content of units and courses in traffic safety education now found in the curriculums of representative school systems	51.7	39.6	7.1	1.6
9.	The services of nonschool agencies to schools offering traffic safety education	48.6	42.6	7.5	1.3

TABLE 3.—PERCENT DISTRIBUTION AMONG ASSIGNED VALUES FOR SURVEY STUDIES (Continued)

Rank	Survey studies	Very useful	Useful	Of little or no value	No answer
1	2	3	4	5	6
10.	Types of street accidents involving school-age children and youth	42.8%	46.5%	9.3%	1.4%
11.	Attitudes of the public as shown by opinion polls on driver education in high schools	44.5	42.5	11.3	1.7
12.	Ways whereby teachers identify and evaluate community resources which can be used in enriching traffic safety education	36.0	53.0	9.8	1.2
13.	Recommendations of classroom teachers on ways whereby available booklets, posters, models, etc. might be made more effective for classroom use	36.8	50.6	11.2	1.4
14.	The number and types of accidents occurring at school (including details on age of children, time of day of accident, month when accident happened, and possible causes)	39.9	42.8	16.3	1.0
15.	The judgments and policies of educational and other professional groups with respect to traffic safety education	35.1	52.5	10.6	1.8
16.	Student judgments of out-of-school experiences which have taught them essential things about traffic safety	36.4	49.1	13.1	1.4
17.	What newspapers, TV, radio, etc. have done to develop public attitudes toward driver education and safety education in general	34.0	53.3	11.2	1.5
18.	Practices of school systems in the grade placement and time allotted to various phases of traffic safety education	35.4	49.9	13.3	1.4
19.	Ways in which schools can identify and organize the content in traffic safety education for use in elementary and secondary schools	34.4	51.7	12.5	1.4
20.	Instructional materials used in elementary schools to teach pupils to observe traffic lights, to follow directions given by members of school safety patrols, and to be safe riders on school buses	38.7	40.1	20.1	1.1
21.	High-school driver education programs compared with those organized for adults (and out-of-school youth) with respect to content, methods of instruction, class size, etc.	39.1	38.4	21.2	1.3
22.	Judgments and experiences of high-school staffs with traffic safety education organized as a part of an existing course, as a separate course, and as an extra-curriculum activity	34.4	47.8	16.2	1.6

TABLE 3.—PERCENT DISTRIBUTION AMONG ASSIGNED VALUES FOR SURVEY STUDIES (Continued)

Rank	Survey studies.	Very useful	Useful	Of little or no value	No answer
1	2	3	4	5	6
23.	Extent and ways in which schools include traffic safety education topics in social studies, health, industrial arts, guidance, science, and other curriculum experiences	33.6%	48.8%	16.5%	1.1%
24.	Staff and organization used in individual schools to coordinate the work in traffic safety education and other phases of safety education	32.9	50.0	15.5	1.6
25.	Materials available to children and youth for use in making charts, models, etc. in traffic safety education	31.7	50.5	16.1	1.7
26.	Practices of schools in providing safeguards, insurance, etc. for pupil transportation programs (including field trips)	31.5	49.6	17.6	1.3
27.	Extent that teachers of traffic safety and driver education are required to have special courses and training in traffic safety	30.9	50.4	17.4	1.3
28.	Judgments and experiences of teachers as to the effect upon learning of various models, booklets, posters, etc. used in traffic safety education	26.4	57.0	15.2	1.4
29.	Judgments and evidence of the contributions that traffic safety education can make to instruction in other areas of the curriculum	28.4	51.4	18.6	1.6
30.	Types of college courses available in traffic safety education	28.7	49.1	20.9	1.3
31.	The goals of traffic safety education compared with those of other areas of the school curriculum	29.0	48.6	20.8	1.6
32.	Reasons given by high-school students for enrolling in driver education	33.1	40.0	25.6	1.3
33.	Judgments of classroom teachers, students, and others as to the effect of contests, competitions, and rewards upon learning in traffic safety education	27.7	49.5	21.6	1.2
34.	Judgments of classroom teachers as to the value of preservice courses in traffic safety education	24.5	54.0	20.3	1.2
35.	The record forms and procedures used by school systems in reporting pupil accidents	25.0	49.5	24.5	1.0
36.	Judgments of classroom teachers and school administrators on the safety and social values of school safety patrols	21.0	50.8	26.3	1.9

Ten Highest Ranking Survey Studies

The top 10 survey studies are grouped and analyzed below. It may be observed that the following areas of research were judged most valuable by those who participated in this survey: (1) over-all evaluations of the driver education program, (2) surveys of effective teaching methods to develop attitudes and skills, (3) findings of research to aid in identifying persons associated with accidents, (4) surveys to aid in locating effective content and instructional materials, and (5) surveys to identify types of street accidents involving children and youth.

1. The first and second studies, with the highest weighted scores, dealt with an over-all evaluation of the driver education program:

> Number and kinds of accidents to students who have taken driver education as compared with similar age groups who have not had driver education (rank 1)

> Judgments of police, judges, and motor vehicle administrators on the strengths and weaknesses they have observed in driver education (rank 2).

2. The third and fourth choices of the respondents were two studies to determine effective teaching methods for developing attitudes and skills:

> Findings of studies of how the attitudes and behavior of individuals change under specific kinds of driver instruction (rank 3)

> Judgments of classroom teachers and others as to the effective teaching technics which improve the behavior of pedestrians and drivers (rank 4).

3. Findings of research which would aid in identifying individuals associated with accidents was the fifth topic chosen:

> Findings of research with respect to the psychological and physical characteristics of individuals involved in accidents (including the equipment and environmental factors involved in the same accidents) (rank 5).

4. The common element of four topics, ranking from sixth to ninth in choice, was the identification of content and materials to enrich traffic safety instruction:

> Types of content material available for classes in traffic safety education, such as traffic control signs, inspection programs for bicycles and cars, and pedestrian safety (rank 6)

> Community resources used by teachers to enrich their instruction in driver education (rank 7)

> The content of units and courses in traffic safety education now found in the curriculums of representative school systems (rank 8)

> The services of nonschool agencies to schools offering traffic safety education (rank 9).

5. The tenth survey study selected dealt with accident statistics:

> Types of street accidents involving school-age children and youth (rank 10).

Ten Lowest Ranking Survey Studies

The lowest 10 ranking survey studies by weighted score included the following areas of research: (1) surveys of some aspects of teacher preparation, (2) surveys of judgments of teachers on the learning effect of specific activities and materials, and (3) surveys of safety education in relation to other areas of the curriculum.

1. Three of the 10 lowest ranking studies proposed to examine some aspects of teacher preparation in safety education:

> Judgments of classroom teachers as to the value of preservice courses in traffic safety education (rank 34)

> Types of college courses available in traffic safety education (rank 30)

> Extent that teachers of traffic safety and driver education are required to have special courses and training in traffic safety (rank 27).

2. Surveys of the judgments of teachers and others on the learning effects of specific activities and materials were the subjects of three of the lowest ranking 10 topics:

> Judgments of classroom teachers and school administrators on the safety and social values of school safety patrols (rank 36)

Judgments of classroom teachers, students, and others as to the effect of contests, competitions, and rewards upon learning in traffic safety education (rank 33)

Judgments and experiences of teachers as to the effect upon learning of various models, booklets, posters, etc. used in traffic safety education (rank 28).

3. Of the lowest 10 topics selected, two involved relationships with other areas of the curriculum:

The goals of traffic safety education compared with those of other areas of the school curriculum (rank 31)

Judgments and evidence of the contributions that traffic safety education can make to instruction in other areas of the curriculum (rank 29).

4. Other survey topics which rank among the lowest 10 are as follows:

The record forms and procedures used by school systems in reporting pupil accidents (rank 35)

Reasons given by high-school students for enrolling in driver education (rank 32).

C. *How All Respondents Ranked the Experimental Studies*

The term *experimental studies* implies research in which there is an effort to identify and evaluate the effect of certain factors in a situation. While these studies may summarize "things as they are," they try to go on to discover why things occur, what increases or decreases the amount of a given condition, and how much effect various factors (such as a specific teaching method) have upon the situation.

Twenty-eight possible experimental studies were listed in the questionnaire. Again, the respondents were asked to check each study as "very useful," "useful," or "of little or no value."

Table 4 shows the suggested experimental studies ranked in order of weighted scores. Again the system of weighting (multiplying the total checks in the three columns by 5, 3, and 1) was applied to arrive at a weighted score.

TABLE 4.—PERCENT DISTRIBUTION AMONG ASSIGNED VALUES FOR EXPERIMENTAL STUDIES

Rank	Experimental type studies	Very useful	Useful	Of little or no value	No answer
1	2	3	4	5	6
1.	The characteristics of drivers with continuous records of safe driving	67.8%	27.4%	3.5%	1.3%
2.	The mental attitudes of pupils which are associated with traffic accidents and how the teacher may identify them	65.5	30.6	3.6	0.9
3.	The validity and reliability of existing tests of knowledge and skills in driver education	65.3	28.1	4.8	1.8
4.	The unique personal habits and characteristics of the careless and reckless driver	64.7	29.4	4.1	1.8
5.	How to identify and measure the attitudes which indicate the student's readiness for driver education	64.0	26.8	7.6	1.6
6.	Effect upon accidents of ability to judge distances, ability to resist glare of lights, breadth of vision, and other visual conditions	60.3	34.1	4.1	1.5
7.	Effect of instruction in traffic laws, principles of good driving, etc. upon the individual's skill as a driver	58.1	35.9	4.4	1.6

TABLE 4.—PERCENT DISTRIBUTION AMONG ASSIGNED VALUES FOR EXPERIMENTAL STUDIES (Continued)

Rank	Experimental type studies	Very useful	Useful	Of little or no value	No answer
1	2	3	4	5	6
8.	The relative importance of skill and knowledge in producing accident-free drivers	56.2%	37.3%	4.7%	1.8%
9.	The role in accident prevention of intelligence, emotional stability, attitudes, and other personal characteristics	56.3	36.8	5.0	1.9
10.	The diagnostic and instructional values of the available tests in driver education	54.6	37.0	6.5	1.9
11.	The instructional value of various kinds of audio-visual aids in teaching driver education	52.3	40.9	5.3	1.5
12.	The extent to which students imitate their elders in various habits and skills which make for traffic accidents	51.8	40.7	5.9	1.6
13.	Conditions under which group influences affect the driving behavior of individual students	49.2	42.9	6.5	1.4
14.	The validity, for teaching purposes, of the so-called "accident proneness" concept	46.1	45.4	6.9	1.6
15.	The outcomes in student learning which may be expected from devices which simulate actual driving (such as mockups of cars in which students sit and manipulate controls, etc.)	49.2	36.5	12.2	2.1
16.	The visual tasks involved in driving upon the streets and highways today	44.3	45.3	8.8	1.6
17.	Outcomes obtained in student learning by the participation of police and other nonschool personnel in a school's instructional program	40.8	50.1	7.0	2.1
18.	The effect of presentations in driver education which deal with citizenship, etc. as contrasted with emphasis upon damage, loss of life, money losses, etc.	41.4	47.7	9.3	1.6
19.	Effect of family patterns of friendliness, cooperation, respect for personality, etc. upon the individual's driving behavior	41.1	47.4	9.7	1.8
20.	Criteria which may be used in selecting effective instructional materials, including the application of these criteria	40.9	46.0	11.1	2.0
21.	The instructional value of case studies of accidents giving details under which traffic accidents have taken place	39.3	48.7	10.7	1.3
22.	The influence of occupation, type of vehicle, and amount of driving upon an individual's driving competence and freedom from accidents	37.1	49.8	10.8	2.3
23.	The negative psychological effects and outcomes of certain types of instruction in driver education	37.5	46.6	12.5	3.4

TABLE 4.—PERCENT DISTRIBUTION AMONG ASSIGNED VALUES FOR EXPERIMENTAL STUDIES (Continued)

Rank	Experimental type studies	Very useful	Useful	Of little or no value	No answer
1	2	3	4	5	6
24.	The relative value in traffic safety education of positive and negative emphases in audio-visual materials, such as the "horror" emphasis in motion pictures	37.5%	45.8%	14.8%	1.9%
25.	The outcomes of both positive and negative methods in presenting selected phases of traffic safety education	35.7	49.6	12.2	2.5
26.	The value of television in teaching skills and improving the attitudes of drivers	33.0	48.5	16.6	1.9
27.	The reading levels of various kinds of instructional materials used in traffic safety education	26.0	54.7	17.7	1.6
28.	Effect upon accident occurrence of such factors as the social-economic status of the driver	25.1	53.3	19.7	1.9

Ten Highest Ranking Experimental Studies

The top 10 studies, as ranked by weighted score, dealt in some way with (1) identifying, (2) measuring and testing, and (3) instructing to correct the personal characteristics, or skills and attitudes, of drivers which are reflected in their driving records.

1. Identifying the characteristics, mental and physical, of drivers with good and poor driving records was the subject of six of the highest 10 ranking topics:

The characteristics of drivers with continuous records of safe driving (rank 1)

The mental attitudes of pupils which are associated with traffic accidents and how the teacher may identify them (rank 2)

The unique personal habits and characteristics of the careless and reckless driver (rank 4)

Effect upon accidents of ability to judge distances, ability to resist glare of lights, breadth of vision, and other visual conditions (rank 6)

The relative importance of skill and knowledge in producing accident-free drivers (rank 8)

The role in accident prevention of intelligence, emotional stability, attitudes, and other personal characteristics (rank 9).

2. Examination of the existing tests in driver education was the subject of three of the topics ranked in the top 10:

The validity and reliability of existing tests of knowledge and skills in driver education (rank 3)

How to identify and measure the attitudes which indicate the student's readiness for driver education (rank 5)

The diagnostic and instructional values of the available tests in driver education (rank 10).

3. The effect of specific content of the course was the subject of the seventh ranking topic:

Effect of instruction in traffic laws, principles of good driving, etc. upon the individual's skill as a driver (rank 7).

Ten Lowest Ranking Experimental Studies

The lowest 10 experimental studies, as ranked by weighted score, included the following general subjects: (1) teaching methods and materials with a negative or competitive slant, and (2) the relationship between a driver's record and certain socio-economic factors.

1. Proposed experimental investigation of particular instructional methods and materials with a negative or competitive slant was the subject of five of the lowest ranking topics:

The outcomes of both positive and negative methods in presenting selected phases of traffic safety education (rank 25)

The relative value in traffic safety education of positive and negative emphases in audio-visual materials, such as the "horror" emphasis in motion pictures (rank 24)

The negative psychological effects and outcomes of certain types of instruction in driver education (rank 23)

The instructional value of case studies of accidents giving details under which traffic accidents have taken place (rank 21)

The criteria which may be used in selecting effective instructional materials, including the application of these criteria (rank 20).

2. Investigation of the relationship between the individual's driving record and certain socio-economic factors was the subject of three of the lowest ranking topics:

Effect upon accident occurrence of such factors as the social-economic status of the driver (rank 28)

The influence of occupation, type of vehicle, and amount of driving upon an individual's driving competence and freedom from accident (rank 22)

Effect of family patterns of friendliness, cooperation, respect for personality, etc. upon the individual's driving behavior (rank 19).

Other topics ranking among the lowest ten included:

The value of television in teaching skills and improving the attitudes of drivers (rank 26)

The reading levels of various kinds of instructional materials used in traffic safety education (rank 27).

D. *Priority Given to Proposed Studies by College and University Respondents*

The returns from 77 college and university professors, engaged in preparing teachers of traffic safety, were selected for separate tabulation. This group has great influence in determining and directing the research for master's and doctor's theses. A few institutions of higher learning have traffic institutes and laboratories devoting much time to research in this field. Also, college and university personnel have a composite view of the traffic safety education problems of both elementary- and secondary-school teachers.

Survey Studies

Again the survey studies were ranked in order of weighted score. An examination of the 10 highest and 10 lowest rated topics indicates that the major areas of survey research which the college and university personnel chose were the same as those chosen by the total respondents. A list of the 10 highest ranking and 10 lowest ranking survey topics, grouped by general subjectmatter, and with rank indicated, follows.

Highest Ranking Survey Topics

1. Two studies with the highest weighted scores dealt with an over-all evaluation of the driver education program:

Number and kinds of accidents to students who have taken driver education as compared with similar age groups who have not had driver education (rank 1)

Judgments of police, judges, and motor vehicle administrators on the strengths and weaknesses they have observed in driver education (rank 3).

2. Survey of effective teaching methods was the subject of two others of the highest ranking topics:

Findings of studies of how the attitudes and behavior of individuals change under specific kinds of driver instruction (rank 2)

Judgments of classroom teachers and others as to the effective teaching technics which improve the behavior of pedestrians and drivers (rank 4).

3. Findings of research which would isolate the characteristics of persons who have accidents was the subject of one topic:

Findings of research with respect to the psychological and physical characteristics of individuals involved in accidents (including the equipment and environmental factors involved in the same accidents) (rank 5).

4. Surveys of accident statistics were ranked relatively higher by the college and university respondents than by the total responding group:

The number and types of accidents occurring at school, including details on age of children, time of day of accident, month when accident happened, and possible causes (rank 6; this study was the 14th choice of the total responding group)

Types of street accidents involving school-age children and youth (rank 7).

5. Surveys of the content and instructional materials available to enrich traffic safety education was the subject of three of the highest 10 ranking survey topics:

Instructional materials used in elementary schools to teach pupils to observe traffic lights, to follow directions given by members of school safety patrols, and to be safe riders on school buses (rank 8; this study was the 20th choice of the total responding group)

The content of units and courses in traffic safety education now found in the curriculums of representative school systems (rank 9)

Types of content material available for classes in traffic safety education, such as traffic control signs, inspection programs for bicycles and cars, and pedestrian safety (rank 10).

Lowest Ranking Survey Topics

1. Among the 10 lowest ranking survey topics, four covered the effects of specific activities and materials on learning:

Judgments of classroom teachers, students, and others as to the effect of contests, competitions, and rewards upon learning in traffic safety education (rank 35)

Judgments and experiences of teachers as to the effect upon learning of various models, booklets, posters, etc. used in traffic safety education (rank 33)

Judgments of classroom teachers and school administrators on the safety and social values of school safety patrols (rank 31)

Materials available to children and youth for use in making charts, models, etc. in traffic safety education (rank 28).

2. The relationship with other areas of the curriculum was the general subject of two of the lowest 10 ranking survey topics:

The goals of traffic safety education compared with those of other areas of the school curriculum (rank 34)

Judgments and evidence of the contributions that traffic safety education can make to instruction in other areas of the curriculum (rank 32).

3. The following four of the lowest ranking survey topics are not related in respect to subject-matter:

Reasons given by high-school students for enrolling in driver education (rank 36)

The record forms and procedures used by school systems in reporting pupil accidents (rank 30)

Attitudes of the public as shown by opinion polls on driver education in high schools (rank 29)

High-school driver education programs compared with those organized for adults (and out-of-school youth) with respect to content, methods of instruction, class size, etc. (rank 27).

Experimental Studies

Altho differing in exact rank, the 10 highest experimental studies, by weighted score, were the same for both the college and university personnel and the total responding group. The major areas of interest were as follows: (1) controlled measurement of the validity and reliability of existing tests in driver education and their diagnostic and instructional values, (2) a determination of the personal, physical, and mental characteristics associated with accidents, so that the accident-liable individual may be identified, and (3) the effectiveness of various types of positive instruction.

There was relatively little difference between the lists of lowest ranking experimental topics as determined by college and university respondents and by the total group of respondents. The subjectmatter covered by the lowest 10 topics as rated by the college respondents is summarized as follows: (1) experiments to determine the value of teaching methods and materials with a competitive slant were the subjects of five topics, and (2) the determination of a relationship between an individual's driving

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record and certain socio-economic factors was the subjectmatter covered by two of the topics. The other three topics were unrelated and included the proposed examination of the reading levels of existing materials in traffic safety education, a determination of the value of police and other nonschool personnel participating in the school program, and an examination of the visual tasks involved in driving.

E. *Other Research Topics Suggested By The Respondents*

The respondents were asked to list other research topics or other types of research they would like to see undertaken.

A total of 726 topics were listed by 484 persons. Over half the respondents listed one or more topics of research. Table 5 summarizes the studies suggested.

Some of these topics would be a logical part of one or more of the survey and experimental topics listed in the questionnaire and discussed in Sections A and B of this report. The research studies suggested by the respondents which were not covered by the listed topics included the following:

1. Survey studies of the financing of driver education
2. Surveys among representative school districts of problems arising from state laws and regulations affecting traffic safety education
3. Surveys of the practices in granting jurisdiction of youthful traffic offenders to the traffic court or to the juvenile court
4. Surveys of the school districts cooperating with traffic court schools
5. Survey studies to determine effective methods of instruction for special groups such as the adult and the slow learner
6. Experimental studies to determine the value of automobile safety equipment in reducing accident occurrence and accident severity

TABLE 5.—SUMMARY OF ADDITIONAL TOPICS OF RESEARCH SUGGESTED BY RESPONDENTS

Additional topics of research suggested	Times mentioned	
	Number	Percent of total
1	2	3
Surveys of technics of teaching	184	25.3%
Surveys of scheduling and programing practices in driver education	94	13.0
Studies of state laws and regulations in regard to driver education with emphasis on the problems they create for the driver education teachers and school administrators	83	11.4
Surveys of state laws governing the ownership and operation of motor vehicles, including traffic laws, apprehension and punishment of violators	62	8.5
Surveys and experimental studies of the personal characteristics and physical conditions common to the accident-liable vs. accident-free driver	60	8.3
Studies to evaluate the driver education program	58	8.0
Studies of effective methods of promoting driver education programs in the schools	41	5.7
Surveys of teachers in regard to preparation for teaching safety education, certification, membership in driver education associations, etc.	39	5.4
Surveys of other school safety activities and controlled measurement of their values	31	4.3
Surveys of problems and practices of financing driver education	25	3.4
Controlled measurement of the effectiveness of safety apparatus available for automobiles	18	2.5
Surveys of problems of procurement of cars for practice driving instruction	14	1.9
Miscellaneous	17	2.3
Total	726	100.0%

7. Survey studies of state laws and regulations governing the ownership and operation of motor vehicles

8. Surveys of school practices in teaching beginning drivers in standard vs. automatic transmission cars.

F. *Research in Which Respondents Would Like To Participate*

Respondents were asked to list any study they would like to make if they had time and resources, and to indicate how they would go about getting the facts. Entries were made in this section by 273 persons or 28.9 percent of the respondents. The value of this section is limited because it is not possible to judge whether the research studies listed will ever be started and completed. The research topics are summarized by general areas of interest as follows.

The subject of 71, or 26.0 percent, of the entries in this section was methods of identifying characteristics common to accident-free and accident-liable drivers. Included here also were studies of methods of instruction which will improve attitudes, increase knowledge and understanding, and alter other personal characteristics found to be associated with individuals with poor driving records.

Evaluative studies of driver education programs were the subjects of 49, or 17.9 percent, of the entries in this section. Most of the proposed studies were limited in scope to an examination of the driving record of former students or to comparing records of trained and nontrained drivers in a particular locality.

The development of course scheduling arrangements, course content outlines, and instructional aids and equipment were the subjects of 42, or 15.4 percent, of the topics. Related studies included here were: (a) proposals to determine the relative values of the classroom and the practice driving phases of driver education, (b) an examination of the value of having student observers in the practice driving car, (c) the development and measurement of the values of audio-visual aids and classroom equipment simulating the experience of driving, and (d) the development of course outlines (some of which proposed a weighting of essential elements to be taught).

Surveys and evaluations of technics of instruction were the subjects of 28, or 10.3 percent, of the studies listed. A few experienced teachers of driver education offered to contribute to the compilation of a booklet of "tips" for the inexperienced instructor.

The following subjects of research were suggested by fewer than 10 percent of the respondents completing this section of the questionnaire: (a) studies of accident statistics, including accident reporting technics and procedures, (b) survey by states of teacher education and certification requirements, (c) surveys of school safety education activities other than driver education, (d) surveys of the role of the school in community safety drives, including cooperation in activities sponsored by out-of-school groups, (e) surveys and critical examination of state driver licensing procedures, (f) surveys of the enforcement of traffic laws and the effects of enforcement upon the attitudes of student drivers, and (g) studies of the relative merits of optional and compulsory driver education.

G. *Summary*

A critical need for the development of a background of supporting research in traffic safety education is indicated by this report. Nearly 1000 safety educators indicated their research needs.

The most critical need was for an evaluation of driver education programs in the public schools. Do trained students have a better driving record than nontrained drivers? How do police, judges, and others before whom traffic offenders come evaluate the driver education program? What are the strengths and the weaknesses of the program?

The second critical need was for the development of research to aid traffic safety educators in identifying accident-free and accident-liable drivers. What are the characteristics of drivers with continuous records of safe driving? What attitudes associated with youth are also associated with traffic accidents?

What combination of attitudes and skills make a safe driver? Can a teacher determine in advance who will be a safe driver and pedestrian as opposed to the student who will have accidents?

The third general area of research asked for by traffic safety educators was a summary of findings of how attitudes and behavior of individuals change under specific kinds of driver instruction. Positive methods of instruction were preferred over methods with a negative or competitive slant.

The fourth subject of research judged most valuable was an examination of the tests of skills and knowledge now used in driver education. Those surveyed expressed the need for controlled measurement studies of how well existing tests predict driving behavior.

The fifth research study area selected was the identification of effective teaching technics which improve the behavior of drivers and pedestrians.

In this survey the frequency of checks in the "very useful" column was higher for experimental topics than for survey topics. Conversely, the frequency of checks in the "of little or no value" column was lower for the experimental than for the survey topics. Thus, the evidence developed in this survey points to the conclusion that, in the judgment of the respondents, there is a greater need for experimental research than for survey research.

10M: 8-56

A Critical Analysis of

DRIVER EDUCATION RESEARCH

Prepared by the
NEA Research Division
in collaboration with the
NEA National Commission
on Safety Education

National Commission on Safety Education
National Education Association
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I. INTRODUCTION

In 1955 the National Commission on Safety Education of the NEA instituted a plan for cooperative research in traffic safety education by appointing a special committee to explore the area, define the task, and suggest how the work could be organized.

Subsequently, and in order to move into an orderly approach to an on-going pattern of research, the Commission appointed a Research Advisory Committee to assist in outlining, planning, and developing studies in the field of Traffic Safety Education. The members of the committee were:

M. R. TRABUE, *Chairman, Professor of Higher Education,* College of Education, University of Kentucky, Lexington

HERBERT S. CONRAD, *Director,* Research and Statistical Services Branch, Office of Education, U. S. Department of Health, Education, and Welfare, Washington, D. C.

MAX R. GOODSON, *Assistant Dean,* College of Education, Ohio State University, Columbus

IRA SCOTT JOHNSON, JR., *Driver Education Teacher,* Ocean City High School, Ocean City, New Jersey

EDWARD LANE-RETICKER, formerly *Assistant Director,* Institute of Government, University of North Carolina, Chapel Hill

J. H. MATHEWSON, *Assistant Director,* Institute of Transportation and Traffic Engineering, University of California, Los Angeles

E. B. NORTON, *President,* State Teachers College, Florence, Alabama

RALPH H. OJEMANN, *Professor,* Psychology and Parent Education, Child Welfare Research Station, State University of Iowa, Iowa City

DEAN M. SCHWEICKHARD, *Commissioner of Education,* State Department of Education, St. Paul, Minnesota

CLARA G. STRATEMEYER, *Supervisor of Elementary Schools,* Montgomery County Board of Education, Rockville, Maryland

J. WAYNE WRIGHTSTONE, *Director of Educational Research,* Board of Education of the City of New York, Brooklyn, New York

Staff

FRANK W. HUBBARD, *Assistant Executive Secretary for Information Services,* NEA

NORMAN KEY, *Secretary,* National Commission on Safety Education, NEA

S. A. ABERCROMBIE, *Assistant Secretary*

Consequently, in the fall of 1955 the Commission requested the Research Division of NEA to make a list of theses and other reports which deal with the outcomes of driver education instruction and to analyze and summarize these studies with the object of (a) identifying the valid and reliable findings which were available for the guidance of classroom teachers and administrators and (b) defining the major areas where additional research might be needed. The major responsibility for this analysis was assumed by David H. Barnes who was assisted by Jean Flanigan.

Procedures Used in Preparing the Report

Several procedures were followed in gathering the basic data for this report.

A form letter was sent to a selected list of 91 deans of graduate schools of education. This letter set forth the objectives of the project and requested summaries or copies of any studies which had been made. Responses were received from 48, or 52.7

percent. Whenever a study was available, it was requested thru inter-library loan.

A further search for theses and dissertations was made by checking *Master's Theses in Education*[1] and *Doctoral Dissertations*[2].

Files of material collected by the National Commission on Safety Education were placed at the disposal of the project. This material included copies of several studies, lists of studies, and correspondence with authorities on traffic safety education.

Visits were made to centers for research, and conferences were scheduled with staff members of those centers. Correspondence with them was initiated and maintained.

An intensive exploration was made of available published material on accidents, traffic safety, highway engineering, and law enforcement. In addition, texts on driver education and the more specific literature of driver education were studied; thru leads in the bibliographies, safety evaluation studies of industrial, commercial, and military driving were found.

Finally, previous reports on driver education evaluations were checked in order to have as inclusive a listing of studies as possible.

[1] Lamke, T. A., and Silvey, Herbert M., editors. *Master's Theses in Education, 1951-52 to 1954-55.* Vol. 1-4. Cedar Falls: Iowa State Teachers College, 1953-1956.

[2] Henry, Edward A., editor. *Doctoral Dissertations Accepted by American Universities.* Vol. 8-11. New York: H. W. Wilson Co., 1941-1944.

Trotier, Arnold H., editor. *Doctoral Dissertations Accepted by American Universities.* Vol. 12-15. New York: H. W. Wilson Co., 1945-1948.

Trotier, Arnold H., and Harman, Marion, editors. *Doctoral Dissertations Accepted by American Universities.* Vol. 16-22. New York: H. W. Wilson Co., 1949-1955.

Limitations of the Report

The report has been limited by the availability of data, which ranged from a simple announcement of results to a complete history and classification of each accident.

The computations of original studies were not checked. In some cases this could not be done; in others it was assumed that the computations were reliable.

Statistical analysis was not extended beyond that inherent in the experimental design of the individual study considered. In other words, if no test was applied to show the statistical significance of differences in performance between driver groups, none was applied. This is not to say that the results presented were not manipulated and rearranged in the process of testing hypotheses. In some cases information about the experimental design was scanty or nonexistent. Such facts as the criteria for matching groups or whether male and female subjects were isolated for comparison could not be ascertained.

The report did not presume to rank the studies discussed. Each study has had its place in the development of research in this field. The strengths and weaknesses of individual studies have served to lead to more comprehensive experimental design and rigor of control.

Altho every effort was made to assemble an exhaustive list of studies, it is possible that some were overlooked. A complete list of the studies known to the author will be found in the Appendix to this report, together with a list of projects planned or reported to be in progress.

II. THE PROBLEM OF YOUTH AND ACCIDENTS

What is the nature and extent of the accident involvement of youth? Is accident proneness a concommitant of youth? What bearing do the nature of youth and proneness toward accidents have upon the problems of traffic safety education and an evaluation of that program?

The accident problem of youth must be examined in relation to the accident experience of the total driving public which is, in turn, a part of the total and complex behavior pattern of the culture. Accident data are confusing, difficult to interpret, and sometimes interpreted fallaciously. However, all the available evidence shows that accidents are disproportionately a phenomenon of the population under 30 years of age.

Youth's Accident Involvement

Moran[3] reported on research which the Center for Safety Education at New York University conducted in cooperation with the Motor Vehicle Departments of Connecticut, Massachusetts, and Wisconsin. In each of these studies, the percents of the *total licensed driving population* represented by the various age groups and the percents of the *total number of accidents* charged against each age group were calculated. Then, an index was developed for each age group to show the degree of accident involvement *in proportion to percent of the population represented.* For example, if an age group representing 10 percent of the licensed population was involved in 10 percent of the total number of accidents, the accident involvement index of the group would be 1.0. The group would be neither over- nor under-involved in comparison with the general population. The findings of these studies are shown in Figure I.

It will be noted that while teen-agers are "over-involved," it is not as great an "over-involvement" as that of the group aged 20 thru 24. Performance does not become "normal" until age 30. This is somewhat contrary to the implications of the use of such a term as *teenicide* in traffic safety propaganda.

A substantially better teen-age record is shown in an analysis of Iowa drivers made by Lauer.[4] Tables 1 and 2 are an abridgment of his material.

In interpreting his material Lauer said:

> Men up to 20 show a deficiency of accidents and violations from that to be expected. In general the difference is highly significant; being far beyond the 1 per cent level. From 20 on through the late thirties the differences are significantly greater than expected.

Lauer also pointed out that women showed a deficiency larger than expected at both ends of the scale. It will be noted that the age for "normal" involvement is later than in the previously cited studies. In this connection Lauer cautions against hasty transfers of generalizations from a study in a specific area. Iowa may present driving conditions different from other places.

What is possibly the most devastating picture of teen-age traffic dereliction is found in a study conducted by the California Youth Authority.

The authors said:

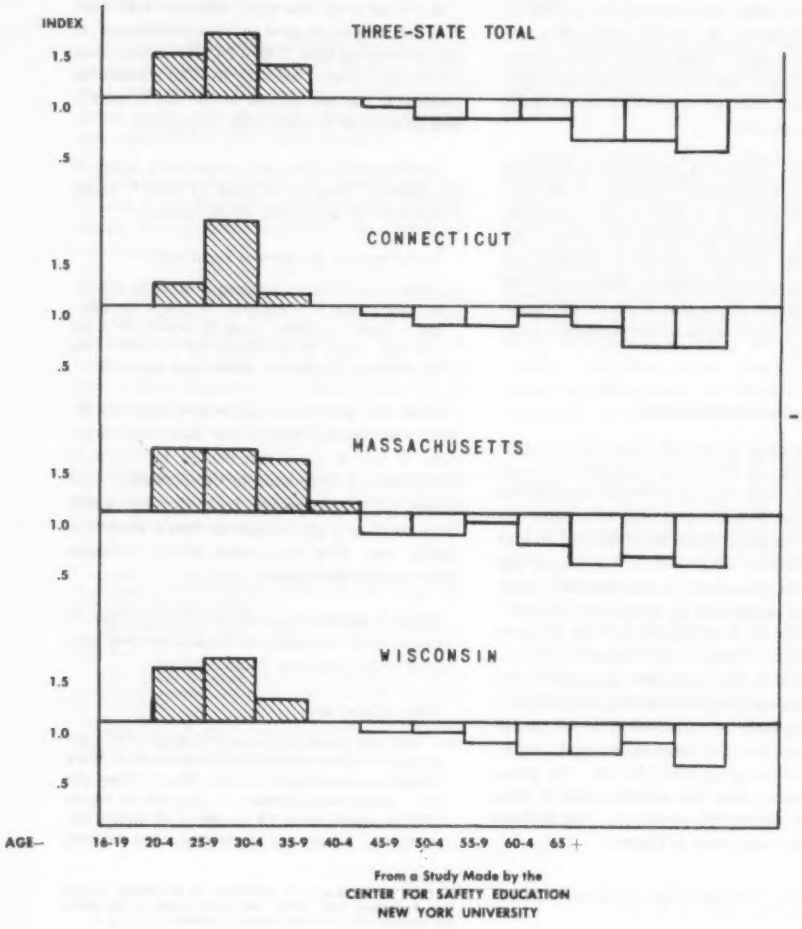
> California has approximately 159,500 juveniles under the age of 18 years licensed by the Department of Motor Vehicles to operate motor vehicles. This is 2.9 per cent of . . . persons issued licenses. . . . Juveniles are responsible for approximately 3.8 per cent of all moving violations . . . 4.8 per cent of the total injury accidents,

[3] Moran, Mary K. "The Accident Rate for High-School Drivers." *Safety Education Digest,* Fall 1951. p. 62-67.

[4] Lauer, A. R. *Analysis of Age Groups in the Driving Population.* Preliminary draft. Ames: Iowa State College of Agriculture and Mechanic Arts, Driving Research Laboratory, 1955. p. 1.

FIGURE I

ACCIDENT-INVOLVEMENT INDICES BY AGE GROUP OF 3,750,000 LICENSED DRIVERS IN THREE STATES — 1947-1948



From a Study Made by the
CENTER FOR SAFETY EDUCATION
NEW YORK UNIVERSITY

4.6 per cent of the total fatal accidents, and 6.5 per cent of the total property damage accidents, as reported by representative police departments throughout the state for the three-year period, 1949 through 1951.[5]

By computing the involvement indexes, the following are obtained: moving violations, 1.3; total injury accidents, 1.7; total fatal accidents, 1.6; and total property damage accidents, 2.2.

A similar trend is shown in Figure II, from a North Carolina study reported by Scheidt.[6]

From a face value interpretation of these studies it would appear that the teen-ager's accident involvement, altho considerable, may have been misrepresented in popular literature, that a more serious problem is presented by his older brothers, that the group

TABLE I.—PERCENTS OF DRIVER LICENSEES, VIOLATIONS, AND ACCIDENTS
(Men drivers in Iowa—1953 sample)

Age	Percent of men in Iowa holding licenses by age group	Percent of all men's licenses in Iowa held by men by age group	Percent (Same as Col. 3) by 5-year group	Percent of all men's violations charged by age group	Percent (Same as Col. 5) by 5-year group	Percent of all men's accidents charged by age group	Percent (Same as Col. 7) by 5-year group
1	2	3	4	5	6	7	8
14	0.649%	0.018%					
15	11.129	0.314					
16	37.615	1.034				0.077%	
17	79.819	2.196		0.304%		0.463	
18	75.232	2.122		2.169		1.658	
19	68.513	1.883	7.567%	0.390	2.863%	1.620	3.818%
20	71.452	1.956		2.000		1.273	
21	71.615	2.086		2.386		3.124	
22	89.540	2.602		3.861		3.432	
23	85.917	2.547		3.904		3.471	
24	81.914	2.436	11.627	3.471	15.622	3.085	14.385
25	86.119	2.695		4.599		4.088	
26	84.230	2.566		5.249		4.667	
27	86.209	2.602		3.948		3.509	
28	86.604	2.732		3.818		3.818	
29	79.888	2.436	13.031	4.035	21.649	4.165	20.247
30	93.340	2.953		4.035		3.664	
31	100.000*	2.842		3.557		4.204	
32	87.000	2.529		3.167		3.509	
33	87.675	2.436		1.692		2.237	
34	74.758	2.141	12.901	2.950	15.401	2.044	15.658

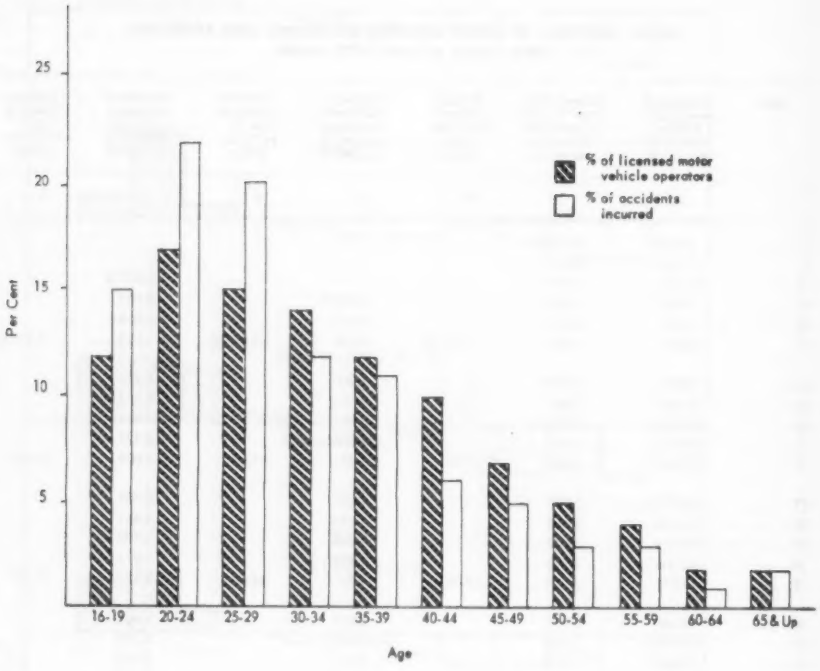
Source: Adapted from: Lauer, A. R. *Analysis of Age Groups in the Driving Population.* Preliminary draft. Ames: Iowa State College of Agriculture and Mechanic Arts, Driving Research Laboratory, 1955, p. 2.
* Probably due to sampling error.

[5] Kenny, John P., and Pursuit, Dan G. *California Juvenile Traffic Study.* Los Angeles: California Youth Authority, 1952. p. 3.

[6] Scheidt, Edward; Moffie, D. J.; and Milton, Charles. *The North Carolina Vision Program.* Raleigh: North Carolina Department of Motor Vehicles, 1954. 27 p.

FIGURE II

PER CENT OF MOTOR VEHICLE OPERATORS AND PER CENT OF ACCIDENTS INCURRED BY AGE GROUPS



SUMMARY: THE INCIDENCE OF ACCIDENTS IS HIGHEST FOR THE AGE GROUPS 16-19, 20-24, AND 25-29.

From a Study Made by the

DEPARTMENT OF PSYCHOLOGY, NORTH CAROLINA STATE COLLEGE

in need of driver education is an out-of-school group, and that the "lasting effects" of driver education are a moot problem. However, it should be noted that these studies concerned number of violations and/or number of accidents only. No allowance was made for "exposure," that is, more driving in terms of time and mileage, and more hazardous conditions such as city traffic, road conditions, and weather conditions. It could well be that the teen-ager has an equal or greater accident potential than the older youth group. The expression of this potential is restricted by his relative immobility, greater dependence, less freedom, less money, and restricted access to alcohol. If this is so, the need for driver education that lasts is indeed further emphasized.

Youth and the Concept of Accident-Proneness

The concept that accidents are a phenomenon of youth raises the question: To what extent are accidents inherent in the nature of youth? This question, in turn, brings up two related considerations,

TABLE 2.—PERCENTS OF DRIVER LICENSEES, VIOLATIONS, AND ACCIDENTS (Women drivers in Iowa—1953 sample)

Age	Percent of women in Iowa holding licenses by age group	Percent of all women's licenses in Iowa held by women by age group	Percent (Same as Col. 3) by 5-year group	Percent of all women's violations charged by age group	Percent (Same as Col. 5) by 5-year group	Percent of all women's accidents charged by age group	Percent (Same as Col. 7) by 5-year group
1	2	3	4	5	6	7	8
14	.....	.....		.....		.....	
15	2.069%	0.147%		.....		.....	
16	17.663	1.225		.....		.....	
17	25.835	1.814		.....		.....	
18	34.276	2.549		2.062%		3.404%	
19	27.552	2.059	7.794%	3.093	5.155%	1.702	5.106%
20	27.398	2.108		1.031		1.276	
21	31.919	2.500		4.124		3.404	
22	29.034	2.304		2.062		1.276	
23	43.079	3.480		3.093		2.128	
24	29.321	2.402	12.794	1.031	11.341	1.276	9.360
25	33.200	2.892		1.031		3.404	
26	31.890	2.696		2.062		2.128	
27	31.399	2.598		1.031		1.702	
28	27.671	2.402		1.031		1.702	
29	40.650	3.382	13.970	4.124	9.279	1.702	10.638
30	29.356	2.598		1.031		2.128	
31	27.251	2.059		2.062		1.702	
32	27.131	2.206		3.093		1.702	
33	36.017	2.745		0.000		4.681	
34	29.231	2.255	11.863	3.093	9.290	2.979	13.192

Source: Adapted from: Lauer, A. R. *Analysis of Age Groups in the Driving Population.* Preliminary draft. Ames: Iowa State College of Agriculture and Mechanic Arts, 1955. p. 2.

(a) the accident-proneness concept, and (b) the characteristics of the accident-prone person. These, in consequence, relate to the extent and depth of the general problems of traffic safety education and, specifically, to technical problems in research design.

According to Gorman[7] the concept of accident-proneness was first advanced in 1926 by Marbe, who "proved" statistically that a person with one accident is more likely to have another than the person who has never had any. To account for this phenomenon, he suggested that some individuals have a proneness toward accidents.

There is a great deal of controversy over the statistical basis of accident proneness. Frequently a small segment of a group is observed to have a high accident incidence. For example, in a Connecticut study less than 4 percent of the group had 36 percent of the accidents.[8] The question is whether this concentration is due to a loading of accident-prone persons, to chance, or to other factors. Mintz and Blum[9], in commenting on this Connecticut study, said that by chance alone 2.4 percent of the drivers would have 21.27 percent of the accidents and concluded that personal accident proneness had been an overemphasized factor. In an analysis of accident statistics, Arbous and Kerrick[10] suggested that this sort of distribution tended to occur when a population was not homogeneous in personal characteristics or environmental factors or both. Their idea did not seem to eliminate the existence of the accident-prone person so much as to indicate that such persons would be evenly distributed thruout a population if all personal-environmental factors were matched or controlled.

A stronger statement was made by McFarland, Moore, and Warren[11] in summarizing accident research:

> In the zeal to prove the existence of accident-proneness and to solve the accident problem by the detection and elimination of the accident-prone, questions requiring solution before accident-proneness could really be adequately investigated were overlooked or unrecognized. Tenuous evidence thus came to receive the status of proof, and optimistic interpretations glossed over fundamental difficulties. . . . Some authors believe that the uncritical acceptance of this kind of evidence has played a large part in perpetuating the concept of accident-proneness to a position of undue prominence in the field of accident investigation.

Further, McFarland, Moore, and Warren felt that the concept of the accident-prone person as one who has accidents because of fixed or absolute personality factors alone was a concept that did not hold up.

A similar view was taken by Larson and others[12] who said:

> Implicit in comparative studies of high and low accident groups is the assumption that a history of accidents means a person is "accident-prone." Nowadays, however, considerable disagreement exists over just what an accident-prone person is. In most cases these disagreements exist because the participants hold different theoretical views. But theory should follow, not precede, reliable research findings. It would seem advisable, then, to rest upon empirical distinctions until sufficient data have been accumulated: only at that time should theoretical proposals be made. Therefore, considering a person with a history of accidents as an "accident repeater" rather than as an "accident-prone" worker will eliminate the errors inherent in preceding data with theory. It also will result in a more uniform understanding of terminology—the lack of which is quite evident at the present time.

One characteristic of accident repeaters is their

[7] Gorman, Thomas. "Accident Proneness." *Today's Health* 32: 32-33; December 1954.

[8] *Ibid.*

[9] Mintz, Alexander, and Blum, Milton L. "A Re-examination of the Accident Proneness Concept." *Journal of Applied Psychology* 33: 195-211; June 1949.

[10] Arbous, A. G., and Kerrick, J. E. "Accident Statistics and the Concept of Accident Proneness." *Biometrics* 7: 340-432; No. 4, 1951.

[11] McFarland, Ross A.; Moore, Roland C.; and Warren, A. Bertrand. *Human Variables in Motor Vehicle Accidents.* Boston: Harvard School of Public Health, 1955. p. 19, 20.

[12] Larson, John C., and others. *The Human Element in Industrial Accident Prevention.* New York: New York University, Division of General Education, Center for Safety Education, 1955. p. 73-74.

youthfulness. Schulzinger[13] found that the tendency to have accidents is, in the main, a phenomenon that passes with age, decreasing steadily after reaching a peak at age 21. This was based on an analysis of 27,000 industrial and 8000 nonindustrial accidents over a period of 20 years. Schulzinger concluded that the relatively small proportion of the population that contributed a disproportionate number of accidents is essentially a shifting group with new persons constantly falling in and out of the group. The excessive liability of youth seems to disappear with age; and in most of the highly accident-prone individuals the tendency disappears with physiological or psychological adaption or with the development of more adequate psychological defenses. And some are killed in the accidents in which they are involved.

In a study of accident-free and accident-repeater bus drivers, Wisely[14] reported that the difference between the two groups could not be attributed to visual acuity, depth perception, night vision, recovery from glare, complex reaction time, or mental ability test scores. Similar findings were reported by Suhr and Lauer.[15] Wisely also found in a qualitative analysis of the Cattell Moving Strip Test that accident-repeaters reacted impulsively in many situations and acted blocked in others.

An emerging concept in the study of accident repeaters is that accidents are related to an individual's "style of life." Wong and Hobbs[16] studied a high-accident group in the bottling department of a brewery with seven criteria in mind: (a) broken homes, (b) juvenile court records, (c) truancy records, (d) irregular work patterns, (e) discharges from jobs, (f) marital discord, and (g) extent known to social agencies other than the juvenile court. They concluded that:

1. The accident-prone worker can be identified by a simple analysis of the frequency of superficial injuries.
2. This tendency toward accidents tends to be a stable characteristic.
3. Those who have the most frequent minor accidents have a disproportionate number of major accidents.
4. The personal history of the high-accident group differs from the low by being marked by evidences of aggression and intolerance for family, social, or work discipline.

Their data are presented in Table 3.

This "style of life" concept of accident involvement has been reinforced by a study made by Tillman.[17] He found statistically significant differences in social adjustment factors between high-accident and low-accident groups of commercial drivers. A resumé of this is shown by Table 4. In summarizing, Tillman said there are three types of individuals who are prone to have accidents: (a) the youthful driver; (b) the driver under the influence of alcohol; and (c) the driver with a history of repeated accidents. It will be noted that these categories are not discrete: one individual driver might be in all three.

Of the youthful driver Tillman said:

> Impulsiveness and unwillingness to accept responsibility are characteristic of immaturity. There is a moderate disdain toward the boundaries set down by childlike life. He drives as he lives and where is there a better place to attempt thrills and experience adventure than behind the wheel of an automobile.

Tillman describes the driver with a history of repeated accidents. He is the product of an unfavorable home environment. Upon this he has built a strong resentment of authority and a tendency to utilize any opportunity to assert his independence. As a child

[13] Schulzinger, M. S. "Accident Proneness." *Industrial Medicine and Surgery*, April 1954. p. 151-52.

[14] Wisely, Harold Martin. *Personal Characteristics of Commercial Bus Drivers Related to Accident Proneness*. Doctor's thesis. Evanston, Ill.: Northwestern University, 1947. 80 p. (Typewritten)

[15] Suhr, Virtus W., and Lauer, A. R. *Review of What Research Shows About Commercial Drivers*. Preliminary draft. Ames: Iowa State College of Agriculture and Mechanic Arts. 3 p.

[16] Wong, W. A., and Hobbs, G. E. "Personal Factors in Industrial Accidents—A Study of Accident Proneness in an Industrial Group." *Industrial Medicine* 18: 291-94; July 1949.

[17] Tillman, William Anthony. *The Psychiatric and Social Approach to the Detection of Accident Prone Drivers*. Master's thesis. London: University of Western Ontario, 1948. 99 p. (Typewritten)

TABLE 3.—PERSONALITY FACTORS OF HIGH-ACCIDENT AND LOW-ACCIDENT WORKERS

High-Accident Group								Low-Accident Group							
Case No.	Broken home	Juvenile court	Truancy	Irregular work	Discharged from job	Marital discord	Social agencies other than juvenile court	Case No.	Broken home	Juvenile court	Truancy	Irregular work	Discharged from job	Marital discord	Social agencies other than juvenile court
1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	x							1							
2		x		x		x		2							
3				x		x	x	3							
4	x						x	4							
5	x	x	x	x	x		x	5							
6								6		x					
7					x	x		7				x			
8		x						8				x			x
9		x	x	x			x	9							
10								10	x					x	
11	x	x						11							
12							x	12		x	x	x			
13		x	x	x			x	13							
14								14							
15					x			15							
16		x	x	x				16							
17		x		x	x			17							

Source: Adapted from: Wong, W. A., and Hobbs, G. E. "Personal Factors in Industrial Accidents—A Study of Accident Proneness in an Industrial Group." *Industrial Medicine* 18: 291-94; July 1949.

he has had tantrums; and has bullied and led gangs. Frequently has he been disciplined in school and been guilty of truancy. As an adult his occupational record has been spotty. His chief value is himself and his goals are the immediate gratification of his needs. Consequently, he has few friends, lives in excesses, and fails his personal and financial obligations. The persistence of the attitudes, poor judgment, and inattention which have failed him in his social adjustment leaves an imprint on his accident record. "He drives as he lives."

Summary

The accident over-involvement of youth is solidly documented. While the proportion of accidents charged to teen-agers is smaller than that of the over-20 group, it still represents a substantial over-involvement. Reconciliation for exposure might show a greater proportionate rate. An attempt to explain this involvement leads into a discussion of accident-proneness, for there is reason to believe that youth is an accident-prone time of life.

The concept of accident-proneness began as a statistical one to explain the large proportion of accidents charged to relatively small groups. In some 30 years of research and discussion little correlation has been discovered between conventional measures of

TABLE 4.—PERSONALITY SURVEY ON GROUP OF TAXI DRIVERS

Personality characteristics		High-accident group—20 men	Low-accident group—20 men	Statistical significance[a] X^2
1		2	3	4
Birth place	Urban	15	15	.....
History of parents	Parents divorced	6	1	4.63
	Excess strictness and disharmony	13	5	6.28
Neurotic traits in childhood life	Excess childhood phobias[b]	11	5	4.48
	Excess aggression in childhood[c]	11	....	23.60
School adjustment	Completed grade school	15	15	.....
	Truancy and disciplinary problems	12	2	10.98
Employment record	Five or more previous jobs	13	7	3.60
	History of being fired	10	4	3.98
Armed service record	Member of armed service	15	9	.....
	Frequent A. W. O. L.'s	11	1	9.60
Marital status and sexual adjustment	Married	8	11	.....
	Admitting sexual promiscuity	8	2	4.00
Social adjustment	Having two or more hobbies	9	17	8.50
	Admitting bootlegging on job	14	3	12.20
	Conscious of physique	11	3	5.40

Source: Adapted from: Tillman, William Anthony. *The Psychiatric and Social Approach to the Detection of Accident Prone Drivers.* Master's thesis. London: University of Western Ontario, 1948. p. 88. (Typewritten)

a. When P. = .05, $X^2 = 3.94$.

b. Enuresis; fear of fires, dark, deep water; excessive day-dreaming, etc.

c. Leader of gang, bully, temper tantrums, juvenile court record, etc.

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psycho-physical and personal factors and accident repetition. A fruitful direction of investigation seems to be a study of the individual's life history in terms of social adjustment. From this has come the "style of life" theory of accident repeaters.

The accident-repeating person becomes a problem in research design for traffic safety education. The presence of an undue number of accident repeaters in one of two groups whose driving performance is being compared could influence the significance of differences in performance.

The "style of life" concept poses a particular problem for the educator. How does a driver education program restructure attitudes which seemingly are at the core of an individual? Eaves and Abercrombie[18] seem to accept this challenge in saying:

> Educators, universally, believe that man can consciously adjust and adapt his own behavior to his environment, that he is a self-determining being. It follows, then, that safety educators believe man can adjust his own behavior so as to avoid accidents. This belief is the cornerstone of all the work done in safety education. By implication, it is evident that safety educators consider most accidents as resulting from human causation. Otherwise, their work would have little meaning.

In addition to implications for research design, the "style of life" concept bears upon more general problems of education than traffic safety alone. The personality sketch of the accident repeater is the sketch of an actual or potential delinquent in many areas of living. Surely such an individual has had a long history of poor school adjustment. If this is so, the closest coordination between guidance workers and safety educators would be advisable.

[18] Eaves, Robert W., and Abercrombie, Stanley A. "Concepts of Accidents." *Journal of Educational Sociology* 20: 85-90; October 1946.

III. PREVIOUS EVALUATIONS OF RESEARCH

To date there have been four comprehensive reports, summaries, or analyses of research on the effectiveness of driver education: (a) *Driver Education Proves Its Worth,*[19] a report issued in 1955 by the American Automobile Association; (b) *Driver Education in High Schools,*[20] originally issued in March 1953 by the Institute of Government, University of North Carolina; (c) *Research on the Accident Reduction Value of High School Driver Education,*[21] released in June 1955 by the Accident Prevention Department, Association of Casualty and Surety Companies; and (d) *Proposed Driver Education Program for Portland Public Schools,*[22] a December 1954 release of the Department of Research and Measurements, Portland (Oregon) Public Schools. Each was designed to meet specific needs and must be so considered. These four publications have been a valuable resource in the preparation of this report.

American Automobile Association Report

The American Automobile Association has a long record of active identification with the promotion of driver education. This has been demonstrated thru the sponsorship and conduct of studies, the preparation and disbursement of instructional materials and equipment, the promotion and subsidizing of teacher education, the facilitation of car procurement, and a continuing public information campaign.

Driver Education Proves Its Worth discussed criteria for research, listed studies, and evaluated them. Two comments are worth noting:

> While there is a wide variation in the results reported in various studies which have been made, the over-all picture indicates that high school students who have completed a high school driving course have substantially better driving records than their classmates who have received no such instruction. Since these courses are a relatively new addition to the high school curriculum, improvements in teaching methods are to be expected during the next few years with a consequent improvement in results.
>
> The results, while varying greatly and sometimes negative, clearly indicate that complete driver education courses reduce traffic accidents at least one-half, and in many cases much more.[23]

Another AAA view is found in *Driver Research Projects.*[24] This October 1955 report says:

> A number of studies of the subject have been made. Many of these have been rather limited in scope. Little information is available on the records of the students several years after completing the course. . . .

The Institute of Government Report

This report, prepared by Edward Lane-Reticker, made an extensive analysis of existing research on the effectiveness of driver education. In addition, he examined cost factors and administrative problems. The intent of the report was, purportedly, to assist the North Carolina Department of Public Instruction in finding answers to some questions, four of which were: (a) Is driver education the responsibility of the schools or of others? (b) If it is the responsibility of the schools, what is its relative importance among

[19] American Automobile Association. *Driver Education Proves Its Worth: Results of Driver Education Programs.* Washington, D. C.: the Association, 1955. 28 p.

[20] Lane-Reticker, Edward. *Driver Education in High Schools.* Chapel Hill: University of North Carolina, Institute of Government, March 1953. Reissued, January 1956. 79 p. (Mimeo.)

[21] Association of Casualty and Surety Companies, Accident Prevention Department. *Research on the Accident Reduction Value of High School Driver Education.* New York: the Association, June 1955. 69 p.

[22] Portland Public Schools, Department of Research and Measurements. *Proposed Driver Education Program for Portland Public Schools.* Portland: Board of Education, December 29, 1954. 22 p. (Mimeo.)

[23] American Automobile Association, *op. cit.*, p. [5-6, 3].

[24] American Automobile Association, Traffic Engineering and Safety Department. *Driver Education Research Projects.* Washington, D. C.: the Association, October 26, 1955. 8 p. (Mimeo.)

the other responsibilities of the schools? (c) What is the best and most practical type of driver education for the state? (d) At what level, (state, county, or local) should the responsibility for driver education be placed. The report raised more questions than it answered. In addition to pointing out the misleading nature of studies which do not discriminate between male and female accident rates, the author said:

> One of the most obvious things about these studies is that they disclose a need for carefully controlled research. On the whole these studies are convincing evidence that driver education can reduce accidents among high school students, but they do not answer the question of the extent of the reduction. It would seem clear that in many cases the extent of reduction has been greatly exaggerated. While some of the present studies are much better than others, all omit from consideration what may be a very important factor: attitude. From the present studies it seems clear that the more carefully controlled a study is the more likely it is to indicate smaller differences between trained and untrained drivers.[25]

The Association of Casualty and Surety Companies Report

This report, *Research on the Accident Reduction Value of High School Driver Education,* is unique in that it was not prepared for the use of, or consideration by, educators. An interest in traffic safety is inherent in the insurance industry. Recent trends in exempting graduates of driver education courses from the insurance rate penalty otherwise applied to drivers under age 25 indicate the interest of the industry in driver education classes as a method of selecting preferred risks.[26]

The report discussed problems of research criteria and experimental control. Four of the seven state studies presented were compared in detail. The summary concluded:

> On the basis of an analysis of the four state studies, the most conservative observation which can be made about the comparative accident experience of trained and untrained drivers is that the trained appear to have 19% fewer accidents than the untrained. (This statement refers to male subjects only.)
>
> The broadest statement which can be made (and this refers only to female subjects) is that trained drivers appear to have 51% fewer accidents than the untrained.
>
> By "manipulating" the four state studies, the accident experience of trained male subjects can be made to appear as much as 32% better than the untrained; and the accident experience of trained female subjects can be made to appear 40% better than the untrained.
>
> Trained females appear to have a better accident record than trained males, and untrained females appear to have a better record than untrained males.
>
> While no really definite trend can be shown in the comparative year-to-year accident experience of trained and untrained subjects, considerable leveling off between the two groups appears to occur with the passage of time.[27]

The synopsis of the report ended with the note:

> The above observations are made entirely on the basis of the face-value results of four state studies. They prove nothing, and should not be accepted as prima-facie evidence of the accident-reduction value of high school driver education.

In 1956 the Association of Casualty and Surety Companies distributed a leaflet, *What Everyone Should Know about High School Driver Education,*[28] a strongly worded recommendation for high quality driver education courses for all secondary-school youth. The section, "Driver Education Deserves a Place in the School Curriculum," included this statement: "Accident statistics, blended with the modern trend toward functional education, point to high school driver education as essential training for modern living."

Proposed Driver Education Program for Portland Public Schools

This report was to be used as a basis for deciding

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[25] Lane-Ketcher, *op. cit.*, p. 50.

[26] From: National Education Association news release of March 4, 1955, "Driver Education Pays Dividends."

[27] Association of Casualty and Surety Companies, Accident Prevention Department, *op. cit.*

[28] Association of Casualty and Surety Companies. *What Everyone Should Know about High School Driver Education.* New York: the Association, 1956. 8 p.

upon a proposed expansion of the local driver education program. It considered accident statistics as an argument for high-school driver education and, borrowing heavily from the Institute of Government's *Research on the Accident Reduction Value of High School Driver Education*, concluded:

> No really conclusive study has been made in this field as yet. Statistics published by state safety departments as well as by some casualty companies and automobile associations, attempt to prove that high school students trained to drive by school instructors will have fewer accidents than others in the same age group who have not received such training. Apparently these figures are not as conclusive as they appear to be. There are statistical defects.
>
> Nor has it been definitely determined whether sufficient benefit could be obtained by classroom driver education alone or whether it is essential to have a combination of classroom and practice driving. Educators in large cities which offer driver training are divided on this question.[28]

[28] Portland Public Schools, Department of Research and Measurements, *op. cit.*, p. 9.

Summary

Several different agencies have analyzed traffic safety education research to meet the requirements of different groups. Their common purpose was to answer the question: What does the research prove as to the accident reduction value of high-school driver education? There were different answers:

1. The AAA concluded that the case was proved, but more research is necessary in specific areas.
2. The Institute of Government suggested that, while the face value of existing research may seem to be convincing, more research is necessary.
3. The Association of Casualty and Surety Companies was noncommital about the value of the research, but felt that social need was adequate justification for an expanded driver education program.
4. The Portland study indicated a need for more adequate research and was noncommital about an expanded program, suggesting that the program be limited to classroom driver education only.

IV. THE PROBLEM OF EXPERIMENTAL DESIGN

The problem of experimental design in traffic safety research involves a consideration of (a) basic criteria of scientific research, (b) validity, (c) criteria of optimum driving performance, (d) specific control factors, (e) the sampling design, and (f) the statistical treatment of the results.

Basic Criteria of Scientific Research

Lauer[30] listed eight tenets which he said should be followed in any scientific investigation and which particularly represent potential pitfalls in dealing with driver research:

1. The problem is duly defined and set up as a hypothesis to be tested in any acceptable form.
2. Necessary assumptions are made and clearly stated.
3. Sufficient data are collected to satisfy the design selected and to establish the validity of the results once the study is completed.
4. The method used is appropriate to the research being carried out and accepted by scientists in general.
5. The data collected are not only capable of being statistically evaluated, but are also tested by some method appropriate for testing significance of results.
6. The results are presented as found for the benefit of anyone wanting to make use of them.
7. The conclusions made are limited to the data presented and are stated with proper qualifications and limitations.
8. The experiment is so designed and described that it may be repeated by others for verification.

[30] Lauer, A. R. *Research in Driver Education.* Address given before the National Safety Congress, October 22, 1952.

The Problem of Validity

In a discussion of validity, Brody and Stack[31] pointed out that this fundamental question does not admit a simple answer. A test needs to be valid in more than a general sense; the question should be, For what is it valid?

Traditionally, experimental educational research has been modeled after the controlled univariate design used by learning theorists. The thesis of such a design is that one, and only one, of a cluster of potential variables may be allowed to vary. In the case of research on the effectiveness of driver education this one variable would be a formal course in driver education. Also, and preferably, all controls would be established before the course so that the research would not be *ex post facto,* as has been the case with all existing studies. Then, in such circumstances, it would be possible to establish a cause and effect relationship between high-school driver education and a driver behavior reflected in statistically significant measures of superior performance as defined by acceptable criteria. This would make it possible to say that the results of the experiment were valid—that driver education and that factor only had accounted for the differences in behavior between two groups. The problem of validity is a major one in the studies surveyed in this report.

Criteria of Optimum Driving Performance

An attempt to measure the effect of driver education must consider the question, What kind of driving is the goal of the instructional program?

In summarizing aspects of this problem, Brody and

[31] Brody, Leon, and Stack, Herbert J., editors. *Highway Safety and Driver Education.* New York: Prentice-Hall, 1954. Chapter 19, "Measuring and Evaluating Results," p. 351-77.

Stack[32] pointed out that there was a difference between "safe" driving and "optimum" driving, that the criteria of accidents and violations were negative, and that more positive "secondary criteria" should be used if possible. These would include such observations as (a) the incidence of near accidents, (b) skill in handling vehicles, (c) reactions in emergencies, (d) courtesy toward other drivers, (e) competence in handling their own emotional difficulties and insight into their own limitations, (f) knowledge of traffic regulations, and (g) care taken of vehicles.

Some research suggests that driving skills alone would be an inadequate criterion. Tillman[33] made a distinction between "good" driving and "safe" driving: The accident repeater is frequently a highly skilled manipulator of his vehicle. This idea was reinforced by Allgaier and Lauer[34] who said, "Safe driving as evaluated by freedom from accidents and good driving as evidenced by adeptness at the wheel are not the same." Undoubtedly, tho, driving skills could supplement other criteria in evolving a composite index of optimum driving.

The incidence of accidents, moving violations, convictions, suspensions, and revocations forms the usual criteria for evaluating traffic behavior. Research findings are usually presented in terms of accident rates. Fatalities, personal injuries, and property damage dramatize the tragedy and cost of the traffic problem. A case might be built for violations or convictions as a more reliable index of driver behavior, on the assumption that since there would be more violations than accidents, the sample size would be increased and a more valid comparison of the behavior of the group with the behavior of the general population would be possible. Curiously enough, however, this last is not the case in many of the studies analyzed —frequently the accident count is higher than the conviction or arrest count! That some relationship exists between violations and accidents is contended by Lauer[35] who, in commenting on characteristics of Iowa drivers said, "Accidents and violations show the same trends and are closely enough associated to warrant checking the violations as an index to potential accidents."

Reliability of Accident Data

All the studies considered in this report based the criteria of optimum driving on accident and/or violation records. Hence, the reliability of these records is of prime importance. These records vary in the bases of reporting and the consistency of reporting. Variations exist in what is legally reportable, the uniformity of reporting, the levels of enforcement, and the uniformity and comprehensiveness of the record-keeping system. The multiplicity of the enforcement agencies is an additional complication.

The insurance rate structure of a state affects accident reporting. For example, it takes $35 damage for an accident to become a statistic in Vermont, $50 in Virginia, $75 in Maryland, and $100 in West Virginia.[36] Other operative factors are the changing design of automobiles and inflation. The "same" kind of damage is more expensive to repair in a later model car. Regardless of the year model, repairing damage costs more in 1956 than it did in 1946.

In addition to such considerations Brody[37] added the question, Have statistics of probability been applied to *reliable* accident data? This is similar to Edgerton's comment, "Accident rates, when used as criteria in accident research, present some problems of quantitative analysis which are not readily solved by the usual statistical technics. This is largely based on the fact that a small percentage of people in any

[32] *Ibid.*

[33] Tillman, *op. cit.*

[34] Allgaier, E., and Lauer, A. R. "A Preliminary Analysis of the Psychophysiological Correlatives of Automobile Manipulation." *American Journal of Optometry* 18: 49-57; February 1941.

[35] Lauer, A. R. *Analysis of Age Groups in the Driving Population, op. cit.*

[36] American Automobile Association. *Digest of Motor Laws.* Twenty-third edition. Washington, D. C.: the Association, 1956. 152 p.

[37] Brody, Leon, and Stack, Herbert J., *op. cit.*, p. 362.

groups studied incur accidents."[38] As was discussed in Section II of this report, the effects of "chance" on the distribution of accidents within groups is a controversial matter and has a bearing on the concept of accident-proneness.

With such variations in comprehensiveness and reliability seemingly inherent in accident data, it can be seen that the geographical scope of a reliable study will be limited. Further attempts to compare studies will be frustrated as long as these basic data are so inadequate.

Specific Control Factors

An array of specific control factors for traffic safety studies has been assembled and discussed by writers in the field. These factors represent an ideal, or optimum, control of variables. They are not discrete items; each relates to all the others. The aggregate forms a demonstration of the complexity, multiplicity, and interrelatedness of the causal human factors in traffic behavior. In an ideal study controls would be established for all.

Age. Driver groups being compared should be matched for age since, as was pointed out in Section II, age is a factor in accident incidence. Tho teen-agers have a lot of accidents, they do not reach the incidence of the over-20 group. Consequently, the performance of a teen-age group is not comparable with that of an older and out-of-school group in measuring the effectiveness of an educational program.

Sex. All the data available indicate that women have fewer accidents than men, both relatively, in terms of exposure, and absolutely, in terms of accident count. Further, according to Lauer,[39] the woman driver starts to improve her performance at the start of her driving career. The number of accidents she has diminishes. The man increases his for the first five years. Failure to recognize this sex difference lets gross distortions come into the findings of several of the early studies.

Not much has been done to account for this sex difference in behavior. One factor could be that driving exposure varies between the sexes. Another explanation might lie in the different roles which the culture assigns to men and to women. Active and aggressive behavior is sanctioned for men far more than for women. However, the long-time trend seems to be toward a breaking down of the sharpness of sex roles. It may be this trend which is reflected in a recent relative increase in fatal accidents in which women drivers were involved—8.8 percent of fatal accidents in 1954, 9.2 percent of them in 1955.[40]

Education. Groups should be matched for educational background. Comparable educational experiences—if the samples are large enough—will equalize intelligence ranges and, thru the school's socialization processes, secure some attitudinal homogeneity. Homogeneity of both factors will tend to be more nearly complete if both groups are high-school graduates from comparable schools in comparable areas, or, if drop-outs are represented proportionately in both groups.

Extent and Nature of Driving Experience. The experiences of drivers differ. Two prime dimensions are time driven and miles driven. Road conditions and weather, urban traffic or rural traffic, day or night driving, peak traffic or light traffic—all have a bearing on accident incidence. The aggregate of these variables constitutes an index of the degree to which a driver has been "exposed" to an accident-breeding environment.

Research workers have met tremendous practical difficulties in matching for exposure. While licensing records give the number of years an operator has

[38] Edgerton, Harold A., Group F chairman. *Research Needed in Mathematical Statistics, Operations Research and Accident Analysis in Relation to Traffic Accident Causes.* Report of the Highway Research Correlation Conference held under the auspices of the National Research Council's Committee on Highway Safety Research. Washington, D. C.: National Research Council, August 22, 1952. p. 52.

[39] Lauer, A. R., *op. cit.*

[40] Travelers Insurance Companies. *Fatal Falacies.* Hartford, Conn.: the Companies, 1952. p. 10.

been licensed, this is not necessarily the length of time he has operated a vehicle. Additional information must be obtained from drivers, either by interview or by questionnaire. According to Stewart,[41] any attempt to control these variables beyond a point is reduced to a "hopeless state of absurdity."

Socioeconomic Factors. Not much is known about the relationship between socioeconomic factors and traffic safety. DeSilva[42] reported studies made in St. Paul, Detroit, and Louisville which indicated a high rate of accident involvement by residents of low income areas. Generally speaking, in Detroit the proportion of drivers having accidents decreased as the neighborhood improved. He assumed that residents of under-privileged areas might have anti-social attitudes which would be reflected in driver performance. This thesis, however, did not apply in a study made in Cleveland by the American Automobile Association[43] which found no significant relationship between economic levels and driving records.

On the basis of the "style of life" concept of driving, it is possible that poor social adjustment and, hence, poor driving habits might be found in a disproportionate rate at each extreme of the economic scale.

Possibly there is a relationship between socioeconomic background and years of school. Thus, dropouts could automatically become members of untrained groups. On the other hand, New York City reported a greater interest in driver education in vocational high schools than in academic high schools, presumably because of the vocational opportunities in commercial driving.[44] Age, socioeconomic background, and attitude are probably intricately interwoven.

Psychophysical Factors. A great deal of research has been done on the relationship between psychophysical factors—visual acuity, reaction time, coordination, and hearing—and driver safety. McFarland, Moore, and Warren,[45] in an exhaustive summary of studies of the characteristics of accident repeaters, found little evidence to suggest that these factors are significant. This view was reinforced by Tillman and Hobbs who said, "In accident proneness the defect is above, not below, the basic ganglia."[46] Consequently, matching groups for psychophysical factors is probably an unnecessary refinement in experimental design.

Intelligence. Groups that have been matched for educational background probably have been matched sufficiently for intelligence. McFarland, Moore, and Warren[47] found no significant report of any relationship between intelligence and driving records except in the extreme low range. Presumably, there would not be many low IQ drivers among high-school graduates.

Attitudes. There is substantial agreement that attitudes are related to traffic safety. The Advisory Group on Highway Safety Research said, "We believe 'attitude' is important, but we are not sure just what it is, or how to improve it."[48]

Attitude has been variously defined. Larson and others spoke of attitude as "a predisposition to behave in a certain way."[49] Frequently in the literature of traffic education, skill and attitude are set up dichot-

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[41] Stewart, Robert C. *An Evaluation of the Driver Education Program in the State of Delaware in Terms of the Performance Records of the Participants in This Program.* Bulletin No. 29-54. Dover, Del.: State Department of Public Instruction, 1955. p. 7.

[42] DeSilva, Harry R. *Why We Have Automobile Accidents.* New York: John Wiley and Sons, 1942. p. 92-93.

[43] American Automobile Association. *Driver Training Reduces Traffic Accidents: One Half.* Washington, D. C.: the Association, 1945. 18 p.

[44] Interview with George Forlano, Bureau of Educational Research, Board of Education of the City of New York, December 1955.

[45] McFarland, Ross A.; Moore, Roland C.; and Warren, A. Bertrand, *op. cit.*, p. 33.

[46] Tillman, W. A., and Hobbs, G. E. "The Accident Prone Automobile Driver." *American Journal of Psychiatrics* 105: 321-31; No. 5, 1949.

[47] McFarland, Ross A.; Moore, Roland C.; and Warren, A. Bertrand, *op. cit.*, p. 34.

[48] President's Highway Safety Conference. *A Highway Safety Research Program.* Report of the Advisory Group on Highway Safety Research. Washington, D. C.: the Conference, April 1949. p. 2.

[49] Larson, and others., *op. cit.*, p. 86.

omously. Cattell[50] bridged the gap with "an interest, within a given stimulus situation, in following a certain defined course of action." He set up a paradigm, "In these circumstances I want so much to do this with that." This concept brings together "set," manipulation (skills), and the object to be manipulated, all within a situation.

Altho there is agreement on the importance of "attitudes," there are technical difficulties in measuring this factor so that groups may be matched. According to McFarland, Moore, and Warren's summary,[51] altho psychological tests might discriminate between accident-free and accident-repeater groups, the evidence was considered tentative and inconclusive. Moreover, typical instruments used do not lend themselves to the treatment of large scale samples.

The crux of the attitude-matching problem is seen by some in what the Association of Casualty and Surety Companies[52] calls "the selective bias of driver education." According to this concept, there is no definitive way of knowing but that the presence of a student in an elective driver education class is an index of his safety attitude. Conversely, it is possible that the accident-prone person or potential accident repeater eliminates himself, or is eliminated from, driver education. Thus, a bimodal distribution would be accomplished.

Of course "selective bias" may be influenced by the organization of the school program. Presumably, it would not operate where driver education was mandatory. Evaluating the outcomes of a compulsory, universal program would demand new and different experimental designs.

The Nature of the Course and the Quality of the Instruction. Qualitative and quantitative differences in the instructional program must be considered. These factors will vary from teacher to teacher, from school to school, from school system to school system, and from time to time. Some control can be established in terms of teacher preparation and certification requirements, curriculum materials, time allotments, and the quality and uniformity of supervision. As Brody[53] pointed out, this is "a control that must be exercised before evaluative research is undertaken." He added, "If the instructor is poorly equipped to give the course or lacks the basic interest to put it across, the experiment has failed before it even began."

The Problem of the Sampling Design

The problem of controls in evaluation is pointed up in a consideration of sampling design: How large need the samples be and how should they be selected?

Roughly speaking, the fewer the controls the larger the sample needs to be. From what has been said about the difficulty of managing specific control factors, it would follow that large samples are indicated in traffic safety research. However, there seems to be no quick and easy formula to use to spell out the optimum sample size for a particular research design.

Sample size and adequacy of control are related to sample selection. A common technic is to select on a random sample basis. A sample must be selected so that it will be representative of the population under study. If this is done, valid generalizations may be made concerning the larger population if appropriate statistical methods are used. A variation is to organize one sample on a random selection basis and then to match the second sample with the first. The refinement of this technic is involved in simultaneous matching of pairs. Probably the most rigorous appli-

[50] Cattell, Raymond B. "Personality Structures as Learning and Motivation Patterns—A Theme for the Integration of Methodologies." *Learning Theory, Personality Theory and Clinical Research.* The Kentucky Symposium. New York: John Wiley and Sons, 1954. p. 99-100.

[51] McFarland, Ross A., Moore, Roland C.; and Warren, A. Bertrand, *op. cit.*

[52] Association of Casualty and Surety Companies, *op. cit.*, p. 5.

[53] Brody, Leon, and Stack, Herbert J., *op. cit.*, p. 368.

cation of this last technic in the history of educational evaluation was that of the Eight Year Study,[54] a project which far transcended in resources of time, money, and staff any study which has been made of traffic safety education.

Statistical Treatment

When samples have been selected, groups matched, appropriate controls established, and performances measured, differences in performance may or may not be in evidence. When a *prima-facie* difference in performance results, certain statistical instruments should be employed in order to determine whether the difference is a "true" one—the groups *are* different—or an apparent one which is caused by chance and/or uncontrolled factors. Frequently, this difference is expressed as being significant on a certain "level of confidence." For example, if a claim is made for a 5-percent level of confidence, this means that only 5 times out of 100 would the results obtained occur by chance. Statisticians differ in defining the optimum measure of rigor. Some will reject findings above the 1-percent level.

This kind of statistical treatment is appropriate to the kind of experimental design which is implied in this discussion of criteria—the univariate design. It is entirely possible that the univariate design is inadequate for and inappropriate to the measurement of such an incredibly complex and subtle thing as driver behavior. Cattell[55] says, "The controlled, univariate experiment, in which nothing but the independent variable alters to an important degree, becomes inapplicable and obsolete—if only because of the limits to our rights of major interference in human lives." He adds, "But multivariate statistical designs do more than provide an effective way of handling what used to be called the controlled variable and the uncontrolled variable in situations where control is impossible." All the studies considered in this report, however, followed in varying degrees, the design and analysis which has been discussed. It may be that the next step in traffic safety research will be to create new research designs in keeping with statistical methods of greater finesse and sophistication.

[54] Chamberlain, and others. *Did They Succeed in College. Adventure in American Education*, Vol. 4. New York: Harper and Brothers, 1941. 291 p.

[55] Cattell, Raymond B., *op. cit.*, p. 108-109.

V. THE STUDIES: THEIR ORGANIZATION AND PROCEDURES

Pertinent to a discussion of studies in traffic safety education is a consideration of why the studies were organized and conducted and a noting of the persons and/or organizations responsible. From a study of the history of the driver education movement these factors would seem to be operative:

1. Evaluation is an established procedure in education.
2. There is often a need to justify the inclusion of new subjectmatter areas or disciplines. In the case of driver education the following arguments are used:
   a. The curriculum is already crowded with "required" subjects.
   b. The complete program of driver education is expensive. Is this extra expenditure justifiable?
   c. Administrative difficulties develop in terms of staff procurement, scheduling, etc.
   d. Philosophical issues develop. Is it the function of the school to teach facts or to inculcate desirable citizenship attitudes? Has not the school already assumed too many functions of the home at the expense of the basic academic program?
3. "Proving the worth" of driver education may be associated with desirable publicity and hence personal and/or commercial advancement.
4. A knowledge of the effects of driver education is needed by the insurance industry.
5. Graduate study projects are afforded to teachers who are working in the traffic safety field.

In a broader sense the problem has been stated by Whitney,[56] a pioneer in safety education, as follows:

> "In a world in which there are so many important things to be done, a subject, to find a place in the curriculum, must not only develop knowledge and technique to meet some immediate situation but must also develop insights into the problems of life in general. Fortunately, the two things go together. The development of ability to meet some important and fundamental situation in life usually brings also these deeper insights. To determine whether the study of safety brings these deeper insights is however the real question at issue from an educational point of view."

Consequently, studies have been organized and conducted by established education research workers, automobile associations, insurance companies, state departments of education, and/or state motor vehicle departments, and graduate students.

Evaluations of driver education have been made for 15 states and 20 local school district programs. In addition, six theses for advanced degrees in education evaluated local driver education programs. No two studies are the same. When the findings of the studies are viewed comparatively, more questions may be raised than have been answered. This is to be expected. It is the nature of scientific inquiry and analysis to open new avenues.

Each study was designed to answer a set of questions varying according to the interests of the agency conducting the study. Seven state departments of education have reported studies: Delaware,[57] Maine, Minnesota, Oregon, Pennsylvania, West Virginia, and the Wisconsin Study of 1945. Other state agencies, including highway and motor vehicle licensing departments, have reported four studies: Arizona, Massachusetts,[58] New Hampshire, and Vermont.

[56] Whitney, Albert W., and Meredith, A. B. "The Fundamental Significance of Safety Education." *The Present Status of Safety Education*. Twenty-Fifth Yearbook, Part I, National Society for the Study of Education. Bloomington, Ill.: Public School Publishing Co., 1926. Chapter 13, p. 327-48. (Quote is from page 328.)

[57] Only the most recent Delaware study is included here. Previous studies were made in 1945 and 1947.

[58] Only the most recent Massachusetts study is included here. Two previous studies have been made.

Most of these studies were developed cooperatively between the state department of education and the other state agencies with one department taking the responsibility for reporting the study. This is not true of the Massachusetts study where one state agency, the Registry of Motor Vehicles, is responsible for the driver education program in the schools as well as for keeping the records on drivers and motor vehicles. Automobile clubs have prepared three state studies: Maryland, Michigan, and New York, and one city study, Cleveland, Ohio. The study of Virginia drivers was prepared by the Mutual Insurance Rating Bureau and the National Bureau of Casualty Underwriters at the direction of the State Corporation Commission. The 1951 study of Wisconsin drivers was a master's thesis; it is the only thesis covering a statewide area. Different agencies were also responsible for the local school district evaluations. School district research or safety departments, police departments, and/or automobile clubs frequently prepared the reports. Six theses evaluating driver education programs were written by teachers of driver education.

Types of Studies

Recent studies have profited from the experiences of the earlier ones. It does appear that the studies are becoming increasingly more scientific in their design, and more reliability can be attached to their findings. Authorities are in general agreement on the criteria of a good study. However, no authority has prescribed a procedure for conducting an evaluation study based on a survey of the experience of trained and untrained drivers which will satisfy all the criteria. Neither is it known to what extent the omission of any one of the criteria affects the results of the study. The discussion which follows in this section emphasizes the procedures used in conducting the several evaluations of driver education which compare the driving records of trained and untrained drivers.

The existing studies may be classified into three general types: (a) trend studies, (b) total group experience comparison studies, and (c) sample group experience comparison studies including random samples of trained and untrained drivers and selected samples of matched groups of trained and untrained drivers.

Trend Studies. The trend study most frequently compares the increase in enrolment in driver education classes with the state or citywide decrease in accidents, fatalities, and/or violations. The figures are given annually over a period of time judged sufficient to establish a trend. This was one of the first technics used to evaluate driver education, but it has not been used recently. Some variation of this technic was used in the following studies: Arizona (1944-1949), Maine (1947-1955), and Stillwater, Oklahoma (1946-1950).

The study of Arizona sutdent drivers represents this type. A driver education program was inaugurated in 1944 under the direction of the state highway department. By 1950, 70 percent of the high schools had elective driver education programs. The reports of this study indicated that driver education was responsible for the reduction in fatal accidents involving high-school students. It seems reasonable to assume that other factors may have been operating at the same time. It is questionable that the number of fatalities and the number of years were sufficient to establish a trend. The following table[59] shows the trend in the number of high-school student drivers involved in fatal accidents:

Year	Number of student drivers involved in fatal accidents
1944	23
1945	11
1946	6
1947	2
1948	3
1949	2

The Maine study is an internal evaluation of the driver education program. This study developed the accident rates of the trained drivers. The accident

[59] American Automobile Association. *Results of Driver Training.* Research Bulletin 39. Washington, D. C.: the Association, 1951. p. 4.

records were not available for the years prior to 1951. For the years available, 1951-1954, a low accident involvement rate is shown for the driver education students. The following table[60] gives the cumulative number of trained licensed drivers and the number and percent involved in accidents for the years 1951-1954:

Year	Cumulative number of trained students	Number of trained students in accidents	Percent of trained students in accidents
1951	4,123	23	0.56%
1952	5,863	43	0.73
1953	8,325	45	0.54
1954	11,270	74	0.66

Total Group Experience Comparison Studies. Some local studies have compared the experience of the total group of trained drivers with the total group of untrained drivers. Studies of this type have been made for Akron, Ohio; Keokuk, Iowa; Racine, Wisconsin; and Toledo, Ohio.

The public schools of Akron checked all reported accidents and a large number of violations involving drivers in the 17-21-year age group. A similar check of male drivers of this age group who had appeared in traffic court showed that only 64 of the 527 drivers with traffic court records were trained drivers. This is a ratio of 7.2 untrained drivers to 1 trained driver. The ratio of untrained drivers to trained drivers in Akron is estimated at 3:1. It was concluded in the report of this study that "high school driver educated drivers do observe traffic laws and regulations better than untrained drivers."[61]

A similar check of the police records of Arlington Heights Township, Illinois, showed no record of traffic offense committed by any graduate of the high-school driver education course. The offenses committed by the untrained group were not reported.

The Bloomington, Illinois, school officials had all student drivers in the high schools complete a questionnaire to compare the accident and violation experience of the driver educated and of the untrained drivers. The accident experience reported was high for both groups. There may have been a tendency for the students to report accidents with negligible damage or to maximize accident experience. The questionnaires were submitted anonymously.

The report of the Vermont study of 1953 indicates that the trained group of drivers, whose records are compared with an equal number of untrained drivers, was the total number of graduates of the driver education course. The untrained group was a sample of untrained drivers of the same age group.

Sample of Trained and Untrained Drivers. The driving records of samples of trained and untrained drivers have been compared in most of the recent state and local studies evaluating driver education. One study, made in West Virginia in 1952, used the random sample technic to select individuals for the samples of trained and untrained drivers.

The technic used by most of the recent studies was first to select large random samples of drivers. From the original random samples, smaller matched samples of trained and untrained drivers were selected for study. Selected samples of matched groups of trained and untrained drivers have been used by 12 of the state studies. Highly selected matched groups of drivers have been used for four of the most recent evaluations: Delaware, Massachusetts, Pennsylvania, and Virginia.

By selecting matched groups of trained and untrained drivers, the weight of the personal and physical factors, which may operate in addition to a driver's status of training, can be represented equally in the samples so that the study may conclude reliably that any difference found between the performance of the trained drivers and the performance of the untrained drivers was due to the influence of driver education. The personal and physical fac-

[60] Maine State Department of Education. *Record of Driver Education Students.* Augusta: the Department, 1955. 2 p. (Mimeo.)

[61] Neuenschwander, W. L. *After Five Years of Driver Education.* Akron, Ohio: Board of Education, 1953. p. 2. (Mimeo.)

tors which are believed to influence a driver's performance are discussed in Section IV. They are age, sex, education, driving exposure, socioeconomic status, physical abilities, intelligence, and attitudes. Other criteria required of a study are that within the area from which the samples are drawn there be uniformity of enforcement of traffic rules and of reporting accidents and violations. For the trained group the quality and quantity of instruction in driver education should be uniform. In the discussion which follows, the arrangements of the several studies for meeting the criteria are examined.

1. *The driving error is used as the basis for evaluating driving performance*—The bases for evaluating driving performance have been the errors recorded by the state license bureaus or local police against individual licensed drivers. No study has been able to measure the secondary criteria. A driver is judged to have a good performance when his record is relatively free from accidents, violations, and suspensions and revocations of his license. The record is inadequate as a measure of driving performance in that it cannot include near accidents, those property damage accidents which are not reported, violations which are not apprehended, and warnings from police officers except where the policeman makes a record of the incident. It is interesting to note here that contrary to expectancy in most of the state studies, the accident rate was greater than the violation rate. Altho some individuals accumulate a record of errors before they become licensed drivers, only one study, New York, has examined these pre-license errors for either driving group. Table 5 gives the driving errors which were the criteria of driving performance for 12 state studies and one city study.

The Delaware study used the broadest base for comparing the driving performance of the trained and untrained groups by including property damage accidents, accidents with responsibility arrest, total accidents, warnings, arrests, and license suspensions. The Massachusetts study limited "accidents" to only fatal and personal injury accidents; property damage accidents were not included. Except for the West Virginia study, all the studies reported violations defined varyingly as arrests, convictions, or citations.

Usually the total number of a group's errors was summarized statistically on a rate basis. The rate might be expressed as a percent of the group involved, as a number per hundred, or as a number per specified number of driving months or years. One study, Vermont, gave only the ratio of the infractions of the trained to the infractions of the untrained group. The rates, however expressed, were then compared. Some studies arranged the data to show those in each group who had one, two, three, etc. errors recorded against their licenses in order to compare the groups as to the number of repeaters.

The studies varied greatly in the way the experiences of the two sample groups were summarized statistically. At the end of five years of the 10-year study, Massachusetts reported only the total number of accidents, prosecutions, and suspensions. No summary was given at this stage of the study. In the Delaware study each specific infraction was given as a number and percent of the drivers involved and as a number and percent of the group involved. The Pennsylvania study reported the number of specific errors charged to each group and the rate of involvement per 100 drivers. The Virginia study summarized the involvement as the number per 100 driver years. The Michigan study used the number per 1000 driving months.

The value of any study is partly dependent upon the consistency and accuracy with which accidents and violations become a part of the records of the licensing bureaus. For the Delaware study, the reporting factor varied little from community to community thruout the state. The Delaware police service and accident reporting are coordinated between the state and local jurisdictions. For states with decentralized police service, it would seem desirable to select the trained and untrained drivers in paired equal numbers from representative communities thruout the state. The Pennsylvania study used this method of selecting the samples.

2. *The design of samples to equate the differences in performance between male and female drivers and between the size of the samples*—Females have a consistently good performance as drivers when compared with males. The inclusion of a preponderance of females in either the trained or the untrained sample lowers the error experience of the sample.

The studies of Minnesota, New Hampshire, Oregon, Vermont, and West Virginia do not give separate statistics for male and female drivers. Neither is it known how many males and females were included in the trained and untrained groups. The Massachusetts study equated for sex differences by including males and females in both samples on a fixed ratio of 4 males to 1 female. The Delaware study, in addition to reporting male and female records separately, also kept as a constant in both sample groups the ratio between males and females.

Several studies have more female drivers in the trained than in the untrained sample: Maryland; Michigan; Pennsylvania; Virginia; Cleveland, Ohio; and DuBois, Pennsylvania. This inequality between the samples may have been compensated to some extent by separate presentation of the records of males and females as a percent or involvement rate per specified number of drivers or months or years of driving.

However, the minimum valid sample is not known in this area. It is estimated roughly that fewer than 10 accidents per year may be expected from 100 males of either group. The accident expectancy for females is even lower. Very little is known about how large the samples of trained and untrained drivers should be to be representative of the entire populations of trained and untrained drivers of both sexes. The solution is partly dependent upon the

TABLE 5.—DRIVING ERRORS USED AS THE BASES FOR EVALUATION OF DRIVING PERFORMANCE BY 12 STATE STUDIES AND ONE CITY STUDY

Studies	Accidents				Accidents with arrest-responsibility charge	Arrests, convictions, violations, warnings	Suspensions and/or revocations
	Fatal	Personal injury	Property damage	Total			
1	2	3	4	5	6	7	8
Delaware			x	x	x	x	x
Maryland				x		x	
Massachusetts	x	x				x	x
Michigan				x		x	
Minnesota				x		x	x
New York				x		x	
New Hampshire				x		x	
Oregon				x		x	
Pennsylvania				x		x	
Vermont				x		x	
Virginia	x	x	x	x		x	
West Virginia				x			
Cleveland, Ohio				x		x	

development of a core of knowledge of automobile accident and violation incidence. A statistical summary, such as a number per hundred, calculated on the records of 500 male drivers is, therefore, of limited comparative value with such a summary calculated on the records of 1000 males. Also, where the individual trained and untrained drivers were selected regardless of sex *in equal numbers from representative communities thruout the state* to equate the urban-rural exposure factor, the subsequent presentation of separate data for males and females, might negate the original urban-rural balance of the groups.

Simultaneous matching for all the factors is indicated. The Massachusetts and Delaware studies are commendable in that the samples were matched simultaneously for local conditions which affect driving as well as for the sex of the drivers.

Table 6 shows the number of males and females and the total number of drivers in the trained and untrained samples.

Many of the studies seem to have used sample groups as large as were available and/or practical

TABLE 6.—THE NUMBER OF MALES AND FEMALES AND THE TOTAL NUMBER OF DRIVERS IN THE TRAINED AND UNTRAINED SAMPLES

Studies	Trained driver sample			Untrained driver sample		
	Males	Females	Total	Males	Females	Total
1	2	3	4	5	6	7
Delaware	617	476	1,093	617	476	1,093
Maryland	194	104	298	199	49	248
Massachusetts	400[a]	100[a]	500[a]	400	100	500
	400[b]	100[b]	500[b]			
Michigan	273	253	526	374	104	478
Minnesota	.....	.....	1,000[a]	.....	.....	1,000
	.....	.....	1,000[b]			
New Hampshire	.....	.....	1,270	.....	.....	1,270
New York	279	187	466	472	223	695
Oregon	.....	.....	5,842	.....	.....	4,281
Pennsylvania	589	911	1,500	1,096	404	1,500
Vermont	.....	.....	925[c]	.....	.....	925
Virginia	384	337	721	435	230	665
Wisconsin (1951)	90[a]	.....	90[a]	.....	.....	90
	90[b]	.....	90[b]			
Wisconsin (1945)	.....	.....	2,500	.....	.....	2,500
Cleveland, Ohio	1,273	607	1,880	1,151	221	1,372

a. Drivers with classroom driver education only.
b. Drivers with complete driver education courses including classroom and practice driving instruction.
c. Total population of trained drivers.

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to work with. The samples vary greatly in size. The largest samples were used in the Oregon study; there were 5842 trained and 4281 untrained drivers. The studies of Cleveland, Delaware, Minnesota, New Hampshire, Pennsylvania, and Wisconsin (1945) also compared samples of 1000 or more drivers. The Massachusetts study is using 500 drivers in each of three groups. The Wisconsin study (1951) used only 90 drivers in each of three groups. A study in New York City is experimenting with samples totaling less than 50 matched individuals.

Only one study reported that the samples were tested to determine if the performance of the drivers selected for inclusion in the samples of trained and untrained drivers was typical of the performance of the populations from which the samples were chosen. The Delaware study reported that the performance of the selected trained group did not differ significantly from the performance of the total population of trained drivers. It was found, however, that the performance of the untrained sample was not typical of the performance of the total population of untrained drivers because the untrained drivers had been selected to match the characteristics of the trained drivers.

3. *Technics used in sampling to equate the urban-rural exposure factor*—The type of traffic condition controls to some extent a driver's chances of accumulating a record of accidents and violations. In selecting the samples of trained and untrained drivers, many of the state studies have considered whether the individuals lived in and consequently did most of their driving in urban or rural traffic situations.

The knowledge of if and how the urban-rural factor was equated in the studies examined is dependent upon details in the formal report of the study, or thru correspondence or interview with the directors or other persons associated with the studies. The Delaware and Massachusetts studies are known to have equated the two samples for this factor. Furthermore, both studies maintained this equation as a constant between the male and female drivers in both groups. Pennsylvania, Vermont, and the two Wisconsin studies are reported to have considered this factor in the selection of samples.

The Vermont study reported this technic: The trained group was the total population of trained drivers. In selecting the untrained group, "particular care was taken that all sections of the state were fairly represented, and that all persons appearing before *each* examiner were included in equivalent proportion."[62]

The Virginia study did not match groups for the urban-rural factor. For the trained group, 89 percent came from urban areas as classified by insurance liability territories. For the untrained group, 37 percent came from urban areas.

4. *Technics used to equate the selective features of driver education*—Many critics of the state and local studies evaluating driver education have charged that the individuals who elect a driver education course are a select group who would be superior drivers without driver education. Their initial interest in safe driving is shown by their enrolment in an optional course.

This generalization is too broad to represent all factors which determine why an individual may elect a course in driver education. Some state laws operate to encourage students to elect driver education for personal and financial advantages in addition to the advantage of learning safe driving. For example, New York State grants licenses to driver education graduates at a lower age than to untrained drivers. Many states permit insurance companies to offer adult rates to automobile owners when the car will be driven by persons under 25 years of age who have completed a high-school course in driver education. In states where such laws are in effect, one could not expect to find a clear division of safety-conscious

[62] News release of the State Motor Vehicle Department, Montpelier, Vermont, February 20, 1953.

students in the driver education courses. In practice another factor which determines an individual's election of the driver education course is conflict in scheduling other courses and co-curricular activities. Any elective subject faces competition with all other elective subjects.

The Virginia study attempted to equate the samples for the course selection factor by selecting for the untrained group only individuals graduating from high schools not offering a course in driver education. Trained drivers were selected only from schools where driver education was required.

The selective bias factor probably is only partly operative between the two samples of trained drivers in the studies of Minnesota and Massachusetts. In these studies, three equal groups of drivers were compared: untrained, trained only in the classroom, and completely trained.

In 1954 a study was proposed for Detroit, Michigan, which was designed to control experimentally the selective factors of the trained driver groups of other studies. Kerlinger[63] proposed to draw samples of trained and untrained drivers from eight Detroit high schools before the individuals became eligible to take the driver education course. The group of students which would receive driver education and the students who would receive no formal training were to be selected by the research workers. The students were to have no choice. This study was not made and probably will not be made.

5. *Equating for age, education, and experience of drivers in the samples*—In some studies the original lists of students who had received driver education and students who had not received driver education were obtained from high-school records. The driving records of these individuals were checked with the state licensing agency. This procedure was followed in the Virginia and West Virginia studies. Other state studies, Vermont and Pennsylvania for example, include as a permanent part of the license record a notation if the licensee had completed a high-school course in driver education. The Pennsylvania Department of Revenue assigns a separate series of numbers to the licenses of trained and untrained drivers of high-school age.

The practice of transcribing the age, status of training, and educational achievement onto the individual's license record greatly facilitates driver education evaluation studies. The average age of high-school attendance automatically controls the age factor in most studies.

The educational achievement factor is more difficult to control. Some studies have used only high-school graduates of a particular year, West Virginia for example. Other studies did not report that the educational achievement factor was considered altho it could be assumed that a minimum age would be set by state school attendance laws. The Virginia study reported that there were more high-school graduates in the untrained than the trained sample, altho the difference was not large.

The following procedure was used in the Delaware study for simultaneous matching of age, sex, educational achievement, length of time licensed, and urban-rural residence. The names of all students enrolled in the driver education program for the school years 1947-48 thru 1949-50 were taken from the records of the State Department of Public Instruction. The number totaled 2494. To secure a sample of untrained drivers, the name of the licensee on every fifth card in the 1948-1950 files of the Motor Vehicle Division was recorded on another master sheet. The number totaled 5000. By cross-checking between the records of the two state agencies, the following information was recorded on the master sheets for each individual in the trained and untrained groups: age, sex, residence (urban-rural), high-school graduate or nongraduate, type of license issued, year license was issued, occupation, driver edu-

[63] Kerlinger, Fred N. *Driver Training Research: Research Proposal and Design.* Detroit: Wayne University, College of Education, April 4, 1954. 6 p. (Mimeo.)

cation program record, and all warnings, arrests, suspensions, and accidents recorded against the driver. A separate Remington-Rand Soundex-Code card was punched for each individual for machine matching of the trained and untrained drivers.

Most of the studies indicated that the driving experience was equated as to the length of time the drivers had been licensed. Frequently only high-school students obtaining licenses in one particular year were included in the samples. Massachusetts, Minnesota, and Pennsylvania used this procedure. In the Delaware and Vermont studies, drivers selected for study had been licensed in three successive years; however, the trained and untrained drivers were represented proportionally for each year. The latter procedure was necessary for small states to obtain samples large enough for comparison.

The length of time a driver has been licensed is at best only a rough indication of his driving exposure. The type of driving and the mileage driven are deemed more important. In the Delaware study all individuals whose occupation primarily involved driving were removed from both samples—taxi drivers, truck drivers, driver-salesmen, and chauffeurs. A questionnaire was sent to all drivers in the final samples asking them to indicate how many miles they drove a year. Approximately a 40-percent return was received. At the 5-percent level of confidence, no significant difference was obtained between the mileage driven by trained and by untrained drivers.

6. *Measuring the lasting effect of driver education*—A few studies have been designed to measure the lasting effect of driver education by reporting the comparative experience of the same groups of trained and untrained drivers at annual intervals such as after the first year of experience, after the second year, etc. For example, the Massachusetts study is designed for interval reporting over a 10-year period. The Minnesota study reported at yearly intervals over a 5-year period. The Vermont and Virginia studies were also designed to measure the lasting effects of driver education thru four years of interval reporting.

7. *Equating for socioeconomic factors*—Only the Cleveland, Ohio, study attempted any analysis of the effect of a driver's socioeconomic status on his driving performance. The trained and untrained groups were not matched for socioeconomic status; information regarding the two groups' socioeconomic status was presented in the report to account for a factor which might have obscured the real effect of driver education.

In Cleveland each census tract was numbered from 1 to 10 indicating the economic level of that tract. Each individual was assigned the number of the economic tract corresponding to the location of his home address. For both the trained and untrained male groups, no significant difference was found in the economic level of those individuals with records of accidents and convictions and those with clear records. The mean economic level did not appear to vary greatly between the trained group and the untrained group.

8. *Comparing the performance of drivers with classroom instruction and practice driving, drivers with classroom instruction only, and drivers with no formal instruction*—One of the questions in the driver education field has been the relative effectiveness of classroom instruction vs. classroom instruction plus practice driving instruction.

Three of the studies—Massachusetts, Minnesota, and Wisconsin (1951)—were designed to compare the driving performance of equal samples of three groups of drivers: one group with no high-school driver education, one group with classroom driver education only, and one group with a complete course in driver education. These studies measure the effectiveness of the degree of training as well as the status of training. This is a commendable plan for evaluation in states or cities which do not have uniformity in the type of driver education offered. The Cincinnati study was limited to a comparison of a partially trained and a completely trained group of drivers.

Uniformity of training was no problem for the

state studies of Pennsylvania and Delaware because the driver education courses thruout the state included both classroom and practice driving instruction and the teachers of driver education are certified by the state departments of education.

A weakness in some of the studies examined has been a failure to equate the trained sample for completeness of the training. For example, the Virginia study defined "trained drivers" as all those who had a minimum of 18 hours of classroom instruction. Some of the studies examined gave no clue to whether the "training" of the trained group was constant or varying.

9. *Technics for statistical validation of the studies* —The use of statistical measures of reliability and significance is deemed necessary in this type of study. First, when any samples are chosen, it is necessary to know if the sample is typical of the universe—the population from which the samples are drawn. Second, when differences in behavior are found between the two samples, it is necessary to know if this difference is statistically significant or can be accounted for by the operation of chance.

Only four of the studies examined made tests of the significance of the differences observed: Delaware, Pennsylvania, Cincinnati, and Cleveland. Only the Delaware study determined if the driving performance of the samples was typical of the performance of the populations from which the samples were selected.

Summary

In the foregoing discussion, successful and unsuccessful procedures used by selected studies have been analyzed in terms of their control of the criteria as discussed in Section IV. The studies were classified as follows: trend studies, total group comparison studies, and sample group comparison studies. Emphasis was placed on the procedures of sample selection to equate the groups so as to balance between them all the factors which influence a driver's record except driver education. None of the studies examined achieved experimental control over all the factors which influence a driver's performance so as to isolate the influence of driver education. In design, each was different from all the others. Each isolated the driver education factor from some, but not all, of the other factors. It is doubtful if a survey type study can be designed which will achieve perfect isolation of the impact of driver education for measurement by statistical technics now in use. According to Stewart[64]

> The conclusions must be interpreted, therefore, with the notation that any superiority which either the trained or non-trained group demonstrates may be the result of the influence of training or lack of training in driver education and/or the unknown and not measured effect of additional variables which have not been included in the study.

The studies are not comparable with respect to the following: the driving errors which were selected as the criteria of driving performance; the size of the samples; the treatment of records of males and females; the equation of the two samples for driving exposure; educational achievement; age; length of time licensed; and years covered by the surveys; and the statistical treatment. No study has been able to deal with the attitude variable.

All the studies faced limitations because of the existing conditions in the area. Many factors were beyond the control of the research workers including who received or did not receive training, the type of training, the intensity and uniformity of traffic law enforcement, the accuracy of reporting, and the availability of records. These studies were *ex post facto* surveys. The design and procedures had to be adapted to the conditions which were in existence at the time of the studies. In many cases where failure to meet the criteria of a scientific study is noted, the failure was not due to errors by the designers of the study; rather, the conditions existing in the area of the study precluded optimum design.

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[64] Stewart, Robert C., *op. cit.*, p. 6.

VI. SUMMARY OF THE RESULTS REPORTED BY STATE AND LOCAL STUDIES EVALUATING DRIVER EDUCATION

The previous section emphasized the design and procedures of the studies viewed collectively in relation to the criteria of a scientific study. This chapter deals with the results found by the individual studies. Pertinent to any consideration of the results are the details of what factors were included in the studies and what factors were omitted. The section is limited to a consideration of the studies which compared groups of trained and untrained drivers.

State Studies

The state studies reviewed here are classified into four main types. The first type consists of those studies in which little or no matching was done between large samples of trained and untrained drivers. Included are the studies of New Hampshire, Oregon, and West Virginia. The second type includes those which compared relatively small matched samples. They are the studies of Maryland, Michigan, and New York. The third type includes those studies which compared fairly large samples of matched groups of trained and untrained drivers. They are the studies of Delaware and Pennsylvania. The fourth type includes those which were designed to measure not only the short-term differences between trained and untrained drivers but also to survey the records of the same two groups over a period of years to measure the lasting effect of driver education. Included here are the studies of Massachusetts, Minnesota, Vermont, and Virginia. In addition, the Massachusetts and Minnesota studies followed the records of three equal samples of drivers: untrained; those who had classroom instruction only; and those who had classroom plus practice driving instruction.

In this section the two Wisconsin studies are omitted since little is known about them except the size of the samples compared and that the results reported were favorable to driver education.

The tables which follow in this section are arrangements of the data given in the reports of the various studies. Unless otherwise indicated, the rate for accidents and violations is expressed as a rate per 100. The index of performance of the untrained group is a *constant at 100 percent.* The index of the trained group is *the percent the rate of the trained group is of the rate of the untrained group.* The difference between the index of the untrained group (100 percent) and the index of the trained group is the percent of superior or inferior performance of the trained group.

Type 1—The studies of Oregon, New Hampshire, and West Virginia compared large groups of trained and untrained drivers. Records of males and females were not separated. The details of sample selection were not reported.

NEW HAMPSHIRE

This study compared the accident and violation records of an equal number of trained and untrained drivers. The report of this study does not indicate how the individuals included in the samples were selected, the proportion of male and female drivers in each group, and the length of time the survey covered. The following table gives the accident and violation experience reported for the trained and untrained drivers:

	Size of sample	Accidents Rate	Accidents Index	Violations Rate	Violations Index
Untrained drivers	1,270	9.3%	100.0	3.4%	100.0
Trained drivers	1,270	2.3	24.7	0.4	11.8

A superior performance of 75.3 percent with respect to accident involvement and 88.2 percent with respect to violation involvement was reported for the trained group.

OREGON

The Drivers License Division of the state kept a "box score" on a selected group of 10,123 drivers representing 49 school districts of the state. This is not a sample study in the usual meaning of the term. Selection of the groups was based on the school district's compliance with the request of the license division to submit the lists of driver education graduates and graduates who had not had driver education. The records represent the experience accumulated over a four-year period. The following table gives the accident and violation experience of the trained and untrained drivers:

	Size of sample	Accidents Rate	Accidents Index	Violations and Warnings Rate	Violations and Warnings Index
Untrained drivers	4,281	41.9%	100.0	25.1%	100.0
Trained drivers	5,842	21.7	51.8	11.0	43.8

The trained group had a superior record of 48.2 percent with respect to accidents and 56.2 percent with respect to violations and warnings. The accident rate appears high for the drivers of both groups. This may be because the Oregon law requires all accidents to be reported regardless of the amount of damage.[65]

WEST VIRGINIA

The drivers included in the trained and untrained groups were selected at random from the licensed drivers of the 1951 graduating classes of West Virginia high schools. The length of time the individuals had been licensed apparently varied. The amount of training given the trained group was constant since the state-approved driver education course included classroom instruction plus six hours' driving and 16 hours' observation. The driver education course was elective. Separate records were not given for male and female drivers. The following table gives the accident experience reported for the trained and untrained drivers.

	Size of Sample	Accidents Rate	Accidents Index
Untrained drivers	927	1.40%	100.0
Trained drivers	1,492	0.27	19.3

The trained driver groups' performance was 80.7 percent better than that of the untrained group.

In summary, the studies of New Hampshire, Oregon, and West Virginia all found that the record of the driver who had had driver education was greatly superior to that of the driver with no high-school course in driver education. Obviously, the influence of driver education has not been isolated from other factors which operated to an unknown extent to produce the superior record of the trained group.

Type 2—Relatively small samples of trained and untrained drivers were used in the evaluation studies of Maryland, Michigan, and New York. All three were conducted under the auspices of the local, state, and/or national offices of the American Automobile Association. In design these studies were comparable. Apparently an effort was made to draw trained and untrained drivers from the same school districts. Rural and urban areas appear to be represented equivalently in the groups compared. However, it does not appear that the urban-rural factor was equated between the males and the females of each sample. The samples of trained and untrained drivers were unequal in size. It is not known if the instruction given to the trained group was a constant or a varying factor.

MARYLAND

For this study, the trained drivers were selected from students completing the driver education course in three semesters, during 1948-49. Their records were compared with students selected from the same schools, tho in unequal numbers, who had not completed a driver

[65] American Automobile Association, *op. cit.*

education course. Only licensed drivers were included in the study. The following results were reported:

	Size of Sample	Accidents Rate	Accidents Index	Violations Rate	Violations Index
Males—untrained drivers	199	5.0%	100.0	16.1%	100.0
Males—trained drivers	194	5.2	104.0	9.8	60.9
Females—untrained drivers	49	4.1	100.0	2.0	100.0
Females—trained drivers	104	2.9	70.7	1.0	50.0
Total—untrained drivers	248	4.8	100.0	13.3	100.0
Total—trained drivers	298	4.4	91.7	6.7	50.4

The accident rate of trained males was 4 percent greater than that of untrained males. However, the violation rate of trained males was 39.1 percent superior to that of the untrained male drivers. When the comparative accident and violation experiences of the sample groups vary greatly, it may be questioned if the samples are typical of the populations they represent. A superior performance of 29.3 percent with respect to accidents and 50.0 percent with respect to violations was found for the trained female group. The total trained group had superior performances of 8.3 percent and 49.6 percent for accident and violation involvement respectively.

MICHIGAN

The records of 1004 drivers were followed in this study. The driving experience averaged 17.5 months. The samples of trained and untrained drivers were unequal in size and also unequal in the proportion of males and females. This was primarily an urban area study. Trained and untrained drivers were selected from the same localities but not in equal numbers. In this study the rates for accident and violation involvement were expressed per 1000 months of driving. The following tables show the accident and violation experience reported by this study:

	Size of sample	Months of driving	Accidents Rate	Accidents Index	Violations Rate	Violations Index
Male—untrained drivers	374	7,523	1.9%	100.0	9.2%	100.0
Male—trained drivers	273	4,168	1.7	89.5	3.1	33.7
Female—untrained drivers	104	1,698	0.0	—	0.6	100.0
Female—trained drivers	253	4,117	0.7	—	1.2	200.0
Total—untrained drivers	478	9,221	1.5	100.0	7.6	100.0
Total—trained drivers	526	8,285	1.2	80.0	2.2	28.9

The trained male driver had a record of superior performance of 10.5 percent and 66.3 percent for accident and violation involvement respectively. The record of the untrained female was superior to that of the trained female with respect to both accidents and violations.

NEW YORK

For the study of New York State trained and untrained drivers, records were checked for students from 43 high schools thruout the state, exclusive of those in New York City. Only licensed drivers were included in the final samples of 695 untrained and 466 trained drivers. It was found that a number of drivers, the majority of whom were untrained males, had a record of accidents and violations without being licensed drivers. These infractions were noted but were not used in computing the relative rates. The study covered one year beginning April 1, 1949. The following table summarizes the results of the New York study:

	Size of sample	Accidents Rate	Accidents Index	Violations Rate	Violations Index
Male—untrained drivers	472	15.2%	100.0	18.4%	100.0
Male—trained drivers	279	13.6	89.5	10.4	56.5
Female—untrained drivers	223	4.9	100.0	2.7	100.0

	Size of sample	Accidents Rate	Accidents Index	Violations Rate	Violations Index
Female—trained drivers	187	7.0	142.8	1.6	59.2
Total—untrained drivers	695	11.9	100.0	13.4	100.0
Total—trained drivers	466	10.9	91.6	6.9	51.5

The trained male group had a superior performance of 10.5 percent in regard to accident involvement and 43.5 percent in regard to violations. The trained female group had an accident record 42.8 percent inferior to the untrained female group; however, the violation record of the trained female group was 40.8 percent superior to that of the untrained female group.

In summary of the studies of Maryland, Michigan, and New York, it may have been noted from the inconsistency of the accident and violation experience, that the samples compared may be too small for reliable conclusions to be drawn.

Type 3—The studies of Delaware and Pennsylvania are included in this category. Both studies compared large matched samples of trained and untrained drivers. Records of males and females were reported separately. The drivers in the trained samples had a standard course in driver education including classroom and practice driving instruction as prescribed by the state departments of education. The studies will be discussed at length individually because they are different in design and used different basic data.

DELAWARE

The study of the records of trained and untrained drivers of the state of Delaware is outstanding for the completeness of the report of the procedures used in conducting the study. The samples compared were large, equal in size, and equal in proportions of male and female drivers. The samples were matched for all primary criteria (e.g., age, sex, urban-rural residence, education, type of license) except attitude toward driving. Driving exposure, as measured by the number of miles driven per year, was surveyed by questionnaire post card. No significant difference at the 5-percent level of confidence was found between the mileage reported by the two groups. All observed differences were tested by using a formula for difference between proportions to determine if the observed difference was significant. Differences were accepted as significant when at least a 5-percent level of confidence was indicated. Trained and untrained drivers were compared with respect to warnings, arrests, license suspensions, total accidents, accidents with responsibility arrest, and accidents with property damage. Both the number of trained and the number of untrained drivers involved in each performance violation and the total number of performance violations recorded against each group were reported. The trained group included driver education graduates for three successive years. The span of experience of the drivers was from two to five years. The following table summarizes the experience reported with respect to accidents and warnings recorded against the groups of untrained and trained drivers.

	Size of sample	Accidents Rate	Accidents Index	Warnings Rate	Warnings Index
Male—untrained drivers	617	44.2%	100.0	48.8%	100.0
Male—trained drivers	617	28.0	63.3	37.3	76.4
Female—untrained drivers	476	10.1	100.0	9.7	100.0
Female—trained drivers	476	5.7	56.4	3.6	37.1
Total—untrained drivers	1,093	29.4	100.0	31.7	100.0
Total—trained drivers	1,093	18.3	62.2	22.6	71.3

The superiority of the trained male driver was 36.7 percent with respect to accident involvement and 23.6 percent with respect to warnings. The superiority of the trained female drivers was 43.6 percent with respect to accidents and 62.9 percent with respect to warnings. The total trained group was 37.8 percent better than the untrained group with respect to accidents and 28.7 percent better with respect to warnings.

The conclusions of the study are summarized as follows. The trained males had a statistically significant superior performance at the 5-percent confidence level over the matched group of untrained males in regard to both numbers of drivers involved and number of incidents recorded in respect to warnings, total accidents, arrests,

accidents with responsibility arrests, accidents with property damage, and license suspensions. Trained females had a statistically significant superior performance over a matched group of untrained females both in total incidents and number of drivers involved in warnings, accidents, and accidents with property damage. The performance of trained females was not significantly superior in respect to arrests, accidents with responsibility arrests, and license suspensions.[66]

PENNSYLVANIA

Sample groups of 1500 trained and 1500 untrained drivers were compared in the Pennsylvania study. An effort was made to represent all sections of the state. The individuals included in the trained sample were graduated from driver education classes the same year (1949-50). Approximately 2½ years' experience was covered by the survey. Only cumulative experience was reported. Untrained drivers were selected to match trained drivers for education, residence, and driving experience. Sex was not a factor treated in the original matching process. Altho records of males and females were presented separately, there was a disproportionately large number of females in the sample of trained drivers. This was equally true of the total population of trained drivers in Pennsylvania. More girls than boys have enrolled in driver education classes.

The following table shows the comparative experience of trained and untrained drivers reported:

	Size of sample	Accidents Rate	Accidents Index	Arrests Rate	Arrests Index
Male—untrained drivers	1,096	9.9%	100.0	7.7%	100.0
Male—trained drivers	589	4.4	44.4	2.2	28.6
Female—untrained drivers	404	3.0	100.0	0.5	100.0
Female—trained drivers	911	1.6	53.3	0.4	80.0
Total—untrained drivers	1,500	8.1	100.0	5.7	100.0
Total—trained drivers	1,500	2.7	33.3	1.1	19.3

The trained male drivers had a 55.6-percent superior performance over the untrained male drivers with respect to accident involvement and a 71.4-percent superior performance with respect to arrests. The trained female operators had a 46.7-percent and a 20.0-percent superior performance over the untrained female in accident and arrest involvement respectively. The performance of the total group of trained drivers was 66.7 percent and 80.7 percent better than that of the untrained group in accident and arrest involvement respectively.

The Pennsylvania study first tested the hypothesis that accidents and arrests are distributed by 50-50 chance among the trained and untrained drivers. The hypothesis was rejected, and the conclusion was reached that accidents were not equally distributed between the trained and untrained drivers. The difference between the assumed and observed differences were found by the chi-square technic to be highly significant. The untrained drivers had a disproportionately large number of accidents and arrests.

The hypothesis that accidents and arrests were distributed equally between males and females of the trained sample and between males and females of the untrained sample was then proposed. The differences between the assumed distribution and the observed distribution were tested by the chi-square technic. In both cases the differences were found to be highly significant. However, it was observed that accidents and arrests were distributed more nearly equally between males and females of the trained sample than between males and females of the untrained sample. Following this study, local school district administrators were advised that more emphasis should be placed on encouraging boys to take the driver education course since the effect of the program was to eliminate the accident and arrest differences between the sexes.

In summary, both the Pennsylvania and Delaware studies are outstanding contributions to driver education evaluation. The Pennsylvania study is a good illustration of the use of a survey in emphasizing a particular problem in driver education, i.e., the preponderance of females in elective driver education courses. The Delaware study is commendable because the sampling and statistical technics were reported in sufficient detail to serve as a model for other studies.

[66] Stewart, Robert C., *op. cit.*, p. 11-12.

Type 4—Four studies were designed to measure the lasting effect of driver education by comparing the records of groups of trained and untrained drivers at intervals over a period of years. From this type of study, deductions can be made from the comparative experience of the first year of driving and that of some subsequent period. These studies are Massachusetts, Minnesota, Vermont, and Virginia. The Massachusetts and Minnesota studies compared the records of three groups of drivers—untrained, trained only in the classroom, and trained in the classroom and given practice driving—in order to assay the relative merits of the two types of driver education.

One question is pertinent in regard to all the studies which compare the records of trained and untrained drivers over a period of years: How many of the individuals will be residents of the state after a period of years or will have been in continuous residence for the entire period of the survey? It may be assumed that during the period of service with the Armed Forces, many males of both groups have been out of the state. This factor may be reflected equally in the records of all of the groups compared. However, its impact on the final results is unknown.

MASSACHUSETTS

The Massachusetts study began January 1, 1950, and will end January 1, 1960. The records of 1500 licensed drivers are being followed. There are 500 drivers without high-school driver education, 500 drivers with classroom driver instruction only, and 500 drivers who have had a complete course in driver education including classroom and practice driving instruction. In each of the groups there are 400 males and 100 females. The drivers included in the final samples were selected from an original larger sample of 25,000 licensed drivers. The individuals in the two trained driver samples graduated from driver education courses the same year. The samples were matched for age, sex, urban-rural residence, and education. The final report of the study will show the lasting advantages of driver education and the relative merits of classroom vs. a complete course in driver education.

To date there have been three reports on the study covering unequal periods of time. Each report gave the infractions accumulated since the beginning of the study. Table 7 was computed from the reported data to show the comparative experience of the three groups at each interval: January 1, 1950, to August 1, 1951; August 1, 1951, to August 1, 1952; and August 1, 1952, to May 15, 1955. It should be noted that the accidents were limited to fatal and personal injury accidents only. Accidents which resulted in property damage only were not included in this study. Accidents were reported as the total number occurring; violations were reported as the number of operators with one or more violations rather than the total number of violations recorded against the group.

From an examination of the table of accidents and violations it can be seen that the superior performance of both trained groups was most obvious in the early stages of driving. In regard to accidents, the most recent period of driving (August 1, 1952, to May 15, 1955) shows both trained groups with an accident index higher than that of the untrained group. In regard to violations, the 50-percent superiority of both trained groups shown in the initial 19 months was reduced to less than 10 percent by the last interval reported (August 1, 1952, to May 15, 1955). When the intervals are compared, there is no constant superiority shown for the group with complete training over the group with classroom training only with respect to both accidents and violations. However, the cumulative experience of the group with complete training is approximately 8 percent superior to the classroom trained in respect to accidents and 19 percent superior in respect to violations.

A discussion of the Massachusetts study would not be complete without a consideration of the relationship between Massachusetts accident reporting practices and the implications of the findings. Reporting only personal injury and fatal accidents limits a realistic comparison of behavior. More chance elements are introduced. Granted that the behavior of the driver or drivers was causal in the impact between two vehicles, chance determined the number of persons in the vehicles and the place where they were sitting at the time of the accident. This type of accident reporting is a dramatic one, but it does not afford a scientific basis for measuring behavior unless samples are very large and the time

span is great. In this instance, the time span may be long (10 years), but the size of the sample may be inadequate. This thesis is reinforced by an examination of the differences in driver performance compared on the basis of violations. In this case, with a larger base, the trained group is superior.

The observations noted above are based on preliminary reports of the study. According to *Accident Facts*,[67] Massachusetts ranked third lowest among the 48 states in the number of traffic fatalities per 100,000,000 vehicle miles. Massachusetts has an intensive safety campaign directed to drivers of all ages. The closeness of the records of the three groups may indicate four factors operating simultaneously: (a) untrained drivers eventually supplement their lack of training thru experience; (b) Massachusetts safe driving and publicity campaigns have been very effective; (c) law enforcement is constant and thoro, and (d) Massachusetts drivers may be approaching an irreducible minimum in amoral traffic behavior.

MINNESOTA

This study is similar to the Massachusetts study in that three groups of drivers were compared: untrained, trained only in the classroom, and completely trained. There were 1000 drivers in each of the sample groups. Their records were reported annually over a period of five years, 1950 thru 1954. The report of this study does not indicate the male and female composition of the three groups, or how and to what extent the individuals in the three groups were matched. Table 8 summarizes the accidents and convictions reported annually for the three groups over the five-year period, 1950 thru 1954.

In regard to both accidents and convictions, the group with complete driver education has a consistently better performance than the group trained only in the classroom and the untrained group. The group with classroom driver education only has a consistently better record than the group with no formal training.

TABLE 7.—THE COMPARATIVE EXPERIENCE OF THREE GROUPS OF MASSACHUSETTS DRIVERS

Item	Number of drivers	January 1, 1950, to August 1, 1951[a]			August 1, 1951, to August 1, 1952[b]			August 1, 1952, to May 15, 1955[c]			January 1, 1950, to May 15, 1955[c]		
		No.	Rate	Index	No.	Rate	Index	No.	Rate	Index	No.	Rate	Index
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Accidents													
Untrained drivers	500	18	3.6%	100.0	9	1.8%	100.0	19	3.8%	100.0	46	9.2%	100.0
Classroom trained drivers	500	10	2.0	55.6	14	2.8	155.6	25	5.0	131.6	49	9.8	106.5
Completely trained drivers	500	16	3.2	88.9	7	1.4	77.8	22	4.4	115.8	45	9.0	97.8
Violations													
Untrained drivers	500	93	18.6	100.0	15	3.0	100.0	65	13.0	100.0	173	34.6	100.0
Classroom trained drivers	500	46	9.2	49.5	40	8.0	266.7	60	12.0	92.3	146	29.2	84.4
Completely trained drivers	500	45	9.0	48.4	12	2.4	80.0	61	12.2	93.8	118	23.6	68.2

a. From: King, Rudolph P. *Highway Safety Through the Eyes of a Motor Vehicle Administrator.* 1951 SAE Beecroft Memorial Lecture. Boston: Registry of Motor Vehicles, 1951. p. 22.
b. From: Lane-Reticker, Edward. *Driver Education in High Schools.* Chapel Hill: University of North Carolina, March 1953. p. 30.
c. From: Mimeographed report from the Registry of Motor Vehicles, Commonwealth of Massachusetts.

[67] National Safety Council. *Accident Facts.* 1955 edition Chicago: the Council, 1955. p. 49.

The data presented in this study can also be arranged to show the relative impact of experience and increased exposure of the three driving groups, or how much each group improved year by year in comparison with the first year of driving. The following table shows the year-by-year fluctuations of accidents and convictions recorded against each group, the group's first-year experience being the base year to which is assigned an index of 100.0.

	1950	1951	1952	1953	1954
Accidents					
Untrained drivers	100.0	136.7	148.3	140.3	80.0
Classroom trained drivers	100.0	131.8	177.3	177.3	72.7
Completely trained drivers	100.0	153.6	171.4	128.6	100.0
Convictions					
Untrained drivers	100.0	196.0	276.0	476.0	428.0
Classroom trained drivers	100.0	207.7	469.2	776.9	630.8
Completely trained drivers	100.0	366.6	733.3	1,833.3	1,233.3

During the second, third, and fourth years of driving, the accident incidence increased for all three groups of drivers. During the fifth year of driving the accident record of the untrained group was 20 percent better than its first-year record. The accident record of the group trained only in the classroom was 27.3 percent better than its record of the first year. The record of the completely trained group was just as good as its record of the first year.

In regard to convictions, there was also a tendency for all three groups to accumulate progressively more convictions during the second, third, and fourth years of driving. A decline occurred during the fifth year of driving. By that year the number of convictions of the untrained group was 4.28 times more than the first year; for the group trained only in the classroom it was 6.31 times greater than the record of the first year; for the completely trained group it was 12.33 times greater than the record for the first year. This increase in number of convictions possibly was caused by the operation of two factors: (a) the individuals of all three groups drove more; and (b) the sharp increase in convictions, but not in accidents, noted for 1953 indicates an increased traffic enforcement program and/or improved reporting practices.

VERMONT

This study was also set up to measure the lasting effect of driver education; however, in design it is entirely different from the other studies examined. The records of 2708 drivers were followed, their experience ranging from one to four years. The trained drivers were from four successive driver education classes, apparently the total number of students graduating from driver education classes in Vermont. Representing all sections of

TABLE 8.—ANNUAL ACCIDENT AND CONVICTION RATES FOR 3,000 MINNESOTA DRIVERS

Item	1950		1951		1952		1953		1954		Total	
	Rate	Index	Rate	Index	Rate	Index	Rate	Index	Rate	Index	Rate	Index
1	2	3	4	5	6	7	8	9	10	11	12	13
Accidents												
Untrained drivers	6.0%	100.0	8.2%	100.0	8.9%	100.0	8.4%	100.0	4.8%	100.0	36.3%	100.0
Classroom trained drivers	4.4	73.3	5.8	70.7	7.8	87.6	7.8	92.8	3.2	66.6	29.0	79.9
Completely trained drivers	2.8	46.6	4.3	52.4	4.8	53.9	3.6	42.8	2.8	58.3	18.3	50.4
Violations												
Untrained drivers	2.5	100.0	4.9	100.0	6.9	100.0	11.9	100.0	10.7	100.0	36.9	100.0
Classroom trained drivers	1.3	52.0	2.7	55.1	6.1	88.4	10.1	84.9	8.2	76.6	28.4	77.0
Completely trained drivers	0.6	24.0	2.2	44.9	4.4	63.8	6.5	54.6	7.4	69.2	21.1	57.2

the state, an equal number of untrained 16- and 17-year-old drivers licensed in the same years were selected at random for comparison. Persons appearing before each examiner were included in equivalent proportions. The report of the study did not indicate if sex and educational achievement were considered.

The first year of driving included the records of 1354 trained and an equal number of untrained drivers; the second year, the records of 925 drivers in each group; the third year, the records of 515 drivers in each group; and the fourth year the records of 209 drivers in each group. The following table compares the accident and conviction experience of trained and untrained drivers:

	Accidents		Convictions	
	Trained	Untrained	Trained	Untrained
1st Year of Driving				
Ratio	1 to 4		1 to 6.3	
Index	25	100	15.9	100
2nd Year of Driving				
Ratio	1 to 2.5		1 to 3.5	
Index	40	100	28.6	100
3rd Year of Driving				
Ratio	1 to 6		1 to 9	
Index	16.7	100	11.1	100
4th Year of Driving				
Ratio	1 to 1.4		0 to 11	
Index	71.4	100	0	100
Composite of all Drivers Thru All Years				
Ratio	1 to 3.4		1 to 5.8	
Index	29.4	100	17.2	100

For each year of experience surveyed the accident and conviction records of the trained group were highly superior to those of the untrained group.

VIRGINIA

The Virginia study followed the records of trained and untrained drivers for a four-year period, 1950 thru 1953. Annual as well as cumulative experience was reported. Records of males and females were given separately. The samples were not equal either in total size or in male and female component parts. The experience of the trained group varied greatly from a minimum of 18 hours of classroom instruction to a complete driver education course including practice driving. The individuals in the sample of trained drivers were selected from graduates of driver education classes in the school year 1948-49. Individuals in the samples of untrained drivers were selected from those attending high schools during the same school year.

In order to remove the selective bias factor, untrained students were selected only from high schools where driver education was not offered; trained students were selected from high schools where driver education was a required course. Unfortunately, with this primary criterion for selecting samples, it was impossible to equate the sample groups on the basis of urban-rural residence. A majority of the trained group was from rural areas and a majority of the untrained group was from urban areas. The authors of the study estimated that equating for this factor would have given a 10-percent additional advantage to the trained group. The estimate was based on the number of claims per 100 driver-years for the insurance policy year 1950 for all carriers within each of the statistical territories within the state. This may be an underestimate. (According to Siebrecht and Eigenauer,[68] a study of accidents involving all age groups in Iowa found that 61 percent of all accidents occurred in population areas of over 25,000 which represented 35 percent of the entire population of the state.)

[68] Siebrecht, Elmer, and Eigenauer, Carl J. *Distribution of Traffic Accident Problems with Respect to Certain Geographical Patterns.* Ames: Iowa State College. 10 p. (Mimeo.)

The following table shows the average accident and conviction experience per 100 driver-years for the trained and untrained drivers for the years 1950 thru 1953.

Type of driver	Number of drivers	Accidents Rate	Accidents Index	Convictions Rate	Convictions Index
Male—untrained	435	5.9%	100.0	6.2%	100.0
Male—trained	384	7.2	122.0	7.8	125.8
Female—untrained	230	1.1	100.0	0.4	100.0
Female—trained	337	0.9	81.8	0.9	225.0
Total—untrained	665	3.9	100.0	3.8	100.0
Total—trained	721	4.6	117.9	5.0	131.6

In regard to both accidents and convictions, the trained male group had a poorer record than the untrained male group. The accident and conviction involvement for all females was low. The trained females had a slightly better record with respect to accidents but a conviction record 2¼ times greater than that of the untrained females.

The following table shows the annual accident rates of the trained and the untrained drivers with respect to accident involvement.

Type of driver	1950	1951	1952	1953	Average 1950-1953
Male—untrained	9.3%	3.9%	5.4%	5.1%	5.9%
Male—trained	8.1	7.6	8.1	5.0	7.2
Female—untrained	0.4	2.2	0.9	0.9	1.1
Female—trained	0.9	1.2	1.3	0.4	0.9
Total—untrained	5.7	3.2	3.6	3.4	3.9
Total—trained	5.1	5.0	5.3	3.2	4.6

The fluctuations of accidents from year to year indicate that the sample groups were not large enough to establish a well-defined trend over the four-year period. Of course, reporting practices may have varied, too.

In summary, the Type 3 studies indicate that the superior performance of the trained group is most evident in the first year of driving. The trained driver does appear to have an initial advantage in ability to avoid accidents and violations. The driver with a complete driver education course appears to have an advantage over the driver with classroom driver education only. However, there is a tendency for the difference in accident and violation rates between trained and untrained groups to decrease over a period of time.

None of the studies subjected the observed differences to tests of statistical significance. The fluctuations in comparative accident and violation rates observed from one reporting interval to another are too great to warrant drawing positive conclusions as to the weight of the interplay of the factors of education, experience, and exposure. For this type of study a need is indicated for larger sample groups, a longer period of study, and/or a wider base for comparison of performance.

A comparison of the driving records of groups of trained drivers shows almost incredible differences in performance among the state studies examined. Table 9 shows this comparison by ranking these groups on a percentage basis.

It will be noted that there is an almost 100-percent range between the superiority found for the trained drivers of West Virginia and the inferiority of the trained drivers of Virginia. It is not possible to conclude that this much difference exists between the driving patterns of the driver populations of these two states. It can be concluded, as was pointed out in Section IV, that the basic data of accident reporting is determined by and limited by the practices prevalent within stipulated political subdivisions. Hence, endeavoring to compare driver behavior on the basis of incomparable state studies is farcical.

TABLE 9.—PERCENT OF SUPERIORITY OR INFERIORITY OF THE ACCIDENT RECORDS OF THE TRAINED DRIVERS COMPARED WITH THE RECORDS OF THE UNTRAINED DRIVERS AS FOUND BY SEVERAL STATE STUDIES

State studies[a]	Total trained group	Trained male group	Trained female group
1	2	3	4
West Virginia	81.7%	—	—
New Hampshire	75.3	—	—
Vermont	70.6	—	—
Pennsylvania	55.6	46.7%	66.7%
Minnesota	49.6[b]	—	—
	20.1[c]	—	—
Oregon	48.2	—	—
Delaware	37.8	37.7	43.6
Michigan	20.0	10.5	0.0[d]
New York	8.4	10.5	—42.9
Maryland	8.3	—4.0	29.3
Massachusetts	2.2[b]	—	—
Virginia	—6.5[c]	—	—

a. Comparative data for the two Wisconsin studies were not available. The studies are arranged in order of superiority of the total trained groups.

b. Group with classroom and practice driving instruction.

c. Group with classroom driver education only.

d. Untrained females had no accident records.

Local Studies

Fourteen studies have evaluated the driver education program of a particular community by comparing the records of groups of drivers. Eight of these studies have been made by school-district or police officials, or by local motor clubs in cooperation with the school districts and police departments. These include the studies of Bay City, Michigan; Bloomington, Illinois; Camden, New Jersey; Cincinnati, Ohio; Cleveland, Ohio; Dubois, Pennsylvania; Racine, Wisconsin; and State College (now University Park), Pennsylvania. Six additional studies have been made by candidates for advanced degrees in education. These studies were made for the following communities: Salt Lake City, Utah (two studies); Olympia, Washington; Pueblo, Colorado; Gibson County, Indiana; and Palo Alto-Los Gatos, California. All the studies, except two, compare the records of trained and untrained drivers. Two of the studies, Cincinnati and Palo Alto-Los Gatos, compare the records of a group of drivers having classroom instruction only with a group having a complete course in driver education.

For the purposes of this report the theses are presented as a unit while the other studies, which are designated as official or semi-official, are discussed individually.

Masters theses[69]—An evaluation of driver education was the subject of five Master's theses and one Doctor's thesis. Four of these are similar: the Anderson study of Salt Lake City; the Bushman study of Salt Lake City; the Pinson study of Olympia, Washington; and the Doyle study of Pueblo, Colorado. In these four studies, Salt Lake City (two), Olympia, and Pueblo, the information on accidents, violations, and other traffic infractions was obtained from the license records of selected samples of trained and untrained drivers. The age and education factors were roughly equated since the original samples were selected from high-school records. Separate data were reported for male and female drivers, except in the Bushman study which was limited to males. The studies matched groups for driving exposure by the number of years the individuals had been licensed drivers. Anderson attempted to collect information on the mileage driven by individuals but was unsuccessful because of a poor return on a post card questionnaire sent to individual drivers.

The data accumulated were given similar initial

[69] Complete references are given in the Appendix.

statistical treatment. All the studies reported the frequency of the particular traffic infraction by both the number of trained and untrained drivers involved and the total number of times the particular infraction was recorded against the group. The results were summarized statistically as a percent or as a rate per 100 drivers. In addition, the Bushman study applied the chi-square test to determine if the observed differences were significant.

The Pinson study did not mention the time interval covered by the study. For the Anderson thesis, both groups of drivers had from one to three years' experience; in the Bushman thesis the groups had from three to six years' experience; and in the Smith thesis the groups had three years' experience. Table 10 summarizes the results of the studies.

The trained male had an accident record 39.4 percent better than the untrained male in the Anderson study of Salt Lake City and 32.4 percent in the Bushman study of the same city, 47.9 percent in the Olympia study, and 29.2 percent in the Pueblo study. In respect to violations, including citations, arrests, and warnings, the trained male had a record 41.2 percent better than the untrained male in the Anderson study, 27.9 percent in the Bushman study, 41.4 percent in the Olympia study, and 41.5 percent in the Pueblo study. The total traffic infraction record of the trained male was better than that of the untrained male by 41.0 percent in the Anderson study, 29.7 percent in the Bushman study, 38.1 percent in the Olympia study, and 38.2 percent in the Pueblo study.

In the three studies which compared samples of female drivers, the difference was most frequently in favor of the trained female; however, the incidence of infractions was small for valid comparison.

The procedure used by Hardesty in his study of the trained and untrained drivers of Gibson County, Indiana, was too different to arrive at results comparable to the four studies summarized above. From official records Hardesty listed the names of drivers 16 to 23 years of age involved in the accidents and violations in the county. Then, by consulting the school records, he determined if the person had completed the course in driver education. He did not compare matched groups of trained and untrained drivers.

The Jones study was the only Doctor's thesis on driver education evaluation. This was a study of drivers with practice driving instruction compared with drivers with classroom driver education only. The two groups were selected from comparable communities, Palo Alto and Los Gatos. The data for comparison were secured by interview with the drivers selected for study. Interviews were completed with 226 drivers with practice driving instruction from Los Gatos and with 217 drivers with only classroom driver education from Palo Alto.

The information collected thru the interview technic was as follows: the age and sex of the driver; the mileage driven during the past five years; the year licensed and the validity of the license; the experience of the driver in accidents and moving violations; and the ownership, age, model, and use of the automobile driven. The chi-square test of significence was applied to the observed difference. The following table is computed from the information given in the text:

Type of driver and type of driver education	Percent with accidents	Index of performance
Males—classroom only	57.4%	100.0
Males—complete program	20.0	35.0
Females—classroom only	39.9	100.0
Females—complete program	28.8	74.6

Jones concluded that the men with behind-the-wheel instruction had significantly fewer accidents at the 1-percent level of confidence than men with classroom driver education only, and that this difference was apparently due to their additional experience in the practice driving car.

The theses examined in this section have met most of the criteria of a good evaluation study. The sampling and statistical procedures were sound. All

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TABLE 10.—COMPARATIVE RECORDS OF TRAINED AND UNTRAINED DRIVERS AS FOUND BY FOUR MASTER'S THESES[a]

Study and sample groups of drivers	Number of drivers	Accidents			Violations			Suspensions and revocations			Total Infractions		
		No.	Rate	Index	No.	Rate	Index	No.	Rate	Index	No.	Rate	Index
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Salt Lake City													
(Anderson's thesis)													
Male—untrained	208	84	40.4%	100.0	158	76.0%	100.0	16	7.7%	100.0	258	124.0%	100.0
Male—trained	208	51	24.5	60.6	93	44.7	58.8	8	3.8	49.4	152	73.1	59.0
Female—untrained	192	11	5.7	100.0	18	9.4	100.0	0	...	...	29	15.1	100.0
Female—trained	192	6	3.1	54.4	8	4.2	44.7	0	...	...	14	7.3	48.3
Total—untrained	400	95	23.8	100.0	176	44.0	100.0	16	4.0	100.0	287	71.8	100.0
Total—trained	400	57	14.2	59.7	101	25.2	57.3	8	2.0	50.0	166	41.5	57.8
(Bushman's thesis)													
Male—untrained	225	130	57.8	100.0	261	116.0	100.0	33	14.7	100.0	424	188.4	100.0
Male—trained	225	88	39.1	67.6	188	83.6	72.1	22	9.8	66.7	298	132.4	70.3
Olympia													
Male—untrained	150	25	16.7	100.0	215	143.3	100.0	7	4.7	100.0	247	164.7	100.0
Male—trained	150	13	8.7	52.1	126	84.0	58.6	14	9.3	197.9	153	102.0	61.9
Female—untrained	100	6	6.0	100.0	12	12.0	100.0	0	...	...	18	18.0	100.0
Female—trained	100	2	2.0	33.3	4	4.0	33.3	0	...	...	6	6.0	33.3
Total—untrained	250	31	12.4	100.0	227	90.8	100.0	7	2.8	100.0	265	106.0	100.0
Total—trained	250	15	6.0	48.4	130	52.0	57.3	14	5.6	200.0	159	63.6	60.0
Pueblo													
Male—untrained	195	171	87.7	100.0	290	148.7	100.0	29	14.9	100.0	490	251.3	100.0
Male—trained	177	110	62.1	70.8	154	87.0	58.5	11	6.2	41.6	275	155.4	61.8
Female—untrained	239	72	30.1	100.0	48	20.1	100.0	1	0.4	100.0	121	50.6	100.0
Female—trained	212	49	23.1	76.7	27	12.7	63.2	1	0.5	125.0	77	36.3	71.7
Total—untrained	434	243	56.0	100.0	338	77.9	100.0	30	6.9	100.0	611	140.8	100.0
Total—trained	389	159	40.9	73.0	181	46.5	59.7	12	3.1	44.9	352	90.5	64.3

a. Complete references are given in the Appendix.

the studies reported results favorable to driver education. All the authors were teachers of driver education who were either teaching or studying in the area which they surveyed. The teachers' knowledge of the driver education program, the local driving conditions, and the reporting and enforcement systems aided materially in the conduct of these studies.

In addition to the foregoing, an examination of these theses affords an interesting sidelight on regional differences in traffic law enforcement. It was pointed out in the analysis of the state studies that frequently the accident count was greater than the violation count. This is not the case in these studies. The enforcement index (the ratio between convictions and accidents) runs from 1.3 to 1.0 in the Pueblo study to 7.8 to 1.0 in the Olympia study.

Official and semi-official studies—The eight official and semi-official studies (conducted entirely or in part by governmental agencies) which compared the records of trained and untrained drivers are discussed separately in this section. A complete report was available for only one, the Cleveland study. The information available on the other studies emphasized the differences found between the records of the groups of drivers rather than the procedures used in conducting the study. Three of these studies (Bay City, Bloomington, and Racine) were total group comparisons of the records of all licensed drivers graduating from high school in a particular year or in attendance at a particular time.

BAY CITY, MICHIGAN

The driving records of trained and untrained drivers who graduated from two Bay City high schools in 1949 were compared. The accidents and violations were limited to those that had occurred by one year after graduation. The results of the study are summarized as follows:

Types of drivers	Number of drivers	Accidents Rate	Accidents Index	Violations Rate	Violations Index
Males—untrained	58	6.9%	—	12.1%	100.0
Males—trained	28	—	—	7.1	58.7

No accidents or violations were reported for the females, including 88 trained and 46 untrained drivers.

BLOOMINGTON, ILLINOIS

All Bloomington high-school student drivers reported their accident involvement to school officials by completing a questionnaire. The following results were reported:

Types of drivers	Number of drivers	Accidents Rate	Accidents Index
Males—untrained	175	28.0%	100.0
Males—trained	68	11.8	42.1
Females—untrained	77	16.9	100.0
Females—trained	86	4.6	27.2

The accident involvement rates of the trained and untrained drivers appear high when compared with those of the other city studies. The information given by the students was not validated thru a check of police records. The accident incidence may be high because the accidents reported included those below the reportable minimum in the state of Illinois.

CAMDEN, NEW JERSEY

In a study of the police records of Camden in 1950, trained males had a higher accident and violation record than untrained males. However, the accident and violation incidence was low; there were only 7 and 9 accidents and 10 and 9 violations recorded against the untrained and trained male drivers respectively. No accidents or violations were recorded against female drivers included in the study. How the samples were selected was not reported. The following table compares the accident and violation experience of the untrained and trained drivers: The rate is expressed as the number per 100 months of driving.

Types of drivers	Number of drivers	Months of driving	Accidents Rate	Accidents Index	Violations Rate	Violations Index
Males—untrained	134	3,431	2.0%	100.0	2.9%	100.0
Males—trained	101	2,078	4.3	215.0	4.3	148.3
Females—untrained	22	490	0.0	—	0.0	—
Females—trained	18	436	0.0	—	0.0	—

CLEVELAND, OHIO

The Cleveland study of trained and untrained drivers is a most comprehensive evaluation of a city high-school driver education program. The samples of trained and untrained drivers compared were large tho unequal in size: 1880 licensed drivers in the trained group and 1372 licensed drivers in the untrained group. Also, they were unequal in the ratios of males and females in the two samples. Both groups were high-school graduates of the classes from June 1939 to June 1941. The trained and untrained drivers were selected in equal proportion from each class. From the state license bureau and the city police files, all accidents and moving violations charged to the individuals in the survey were recorded. By virtue of residence in Cleveland, it was assumed that the drivers faced similar driving conditions. The individuals in the trained group had received the same amount and quality of training.

An enforcement index was shown for the city for the period of the study and the economic status of the individuals in both groups was examined to eliminate or account for other factors which might have obscured the real effect of driver education.

The procedure for determining the economic status of the individuals is interesting. Each census tract in the city of Cleveland had been assigned a number from 1 to 10 indicating the economic level of that tract. By checking the individual addresses with the census map it was possible to assign a number indicating the economic level of each driver. The economic level had no appreciable effect on either group with respect to those with clear records and those with accidents and violations. However, the untrained men with clear records had a slightly higher economic level than trained men with clear records. The trained group had a preponderance of individuals in the economic levels 1 and 10; the preponderance of untrained drivers was in the economic levels of 6, 7, and 8.

All differences between the two groups were tested statistically to determine if the observed difference was significant. No significant difference was found between the records of untrained and trained females. The number of accidents and convictions of females were too few for comparison. The fellowing table compares the accidents and violations of male drivers; the rate is expressed as the number per 100 months of driving since graduation.

Types of drivers	Number of drivers	Months licensed since graduation	Accidents Rate	Accidents Index	Convictions Rate	Convictions Index
Males—untrained	1,151	14,164	5.38%	100.0	12.7%	100.0
Males—trained	1,273	17,166	2.80	52.0	10.6	83.5

The trained group had a superior performance of 48.0 percent with respect to accidents and 16.5 percent with respect to convictions. This is the major source of the frequently repeated statement: Driver education reduces accidents by one-half.

DU BOIS, PENNSYLVANIA

Small samples of trained and untrained drivers were compared for DuBois, Pennsylvania. The results are given in the table below. The rates are expressed as the number per 1000 months of driving.

Types of drivers	Number of drivers	Months of driving	Accidents Rate	Accidents Index	Violations Rate	Violations Index
Males—untrained	49	1,359	0.7%	—	6.6%	100.0
Males—trained	51	1,286	0.0	—	3.1	47.0
Females—untrained	5	145	0.0	—	0.0	—
Females—trained	60	1,315	0.8	—	0.0	—

RACINE, WISCONSIN

The Racine study was an analysis of the records of all student licensed drivers graduating from two high schools from February 1947 to January 1950. The following table gives the reported results:

Types of drivers	Number of drivers	Accidents Rate	Accidents Index	Arrests Rate	Arrests Index
Males—untrained	446	34.1%	100.0	40.5%	100.0
Males—trained	164	9.1	26.7	16.5	40.7
Females—untrained	160	8.0	100.0	2.5	100.0
Females—trained	343	3.5	43.8	1.2	48.0

The trained males had a superior performance of 73.3 percent with respect to accidents and 59.3 percent with respect to arrests. The trained females had a superior performance of 56.2 percent with respect to accidents and 52 percent with respect to arrests.

STATE COLLEGE, PENNSYLVANIA

The State College (University Park) study was the first of the driver education evaluation studies. Accident records accumulated from 1936 thru 1938 by 250 trained and an equal number of untrained drivers of the same age and driving experience were compared.

Records of males and females were not reported separately. By definition, accidents were limited to those in which the driver was declared legally at fault. The results were reported as follows:

Types of driver	Number of drivers	At fault accidents Rate	Index
Untrained	250	3.6%	100.0
Trained	250	0.8	22.2

The trained drivers had a 77.8-percent superior performance with respect to accidents where the driver was declared legally at fault.

CINCINNATI, OHIO

The preliminary report of a study made in Cincinnati, Ohio, compared students who had received a complete course in driver education including classroom and practice driving instruction with a sample of students who had received classroom instruction only. The details of the matching arrangement are not known; however, the study was described by the AAA as "a rather carefully controlled study . . ."[70] Observed differences were tested for statistical significance. The rates are expressed as the number per 1000 months of driving.

The following table summarizes the preliminary results of the study.

Types of drivers	Number of drivers	Months of licensed driving	Chargeable accidents Rate	Index	Moving Violations Rate	Index
Males						
Classroom trained	880	22,733	4.92%	100.0	13.98%	100.0
Completely trained	708	15,149	4.88	99.2	10.75	76.9
Females						
Classroom trained	498	10,246	1.46	100.0	2.04	100.0
Completely trained	514	9,893	0.60	41.1	0.70	34.3

The two groups of male drivers had almost the same accident record. The male drivers with a complete course in driver education had a superior performance of 23.1 percent with respect to moving violations. The female drivers with complete training had a performance superior to the females trained only in the classroom of 58.9 percent with respect to accidents and 65.7 percent with respect to violations.

Summary

The official or semi-official local studies are not comparable with respect to procedures or results. However, all the studies, with the exception of that of Camden, reported results favorable to the trained drivers.

Four of the Master's theses used comparable procedures and arrived at comparable results. These studies, the two of Salt Lake City, the one of Olympia, and the one of Pueblo, found the trained male and female drivers superior to the untrained drivers. Furthermore, the percent of superiority for the trained groups did not differ greatly among these four studies.

Two studies, one official and one a Doctor's thesis, which measured performance of drivers trained only in the classroom in comparison with drivers who had complete driver education courses, arrived at mixed results. The official study of Cincinnati found that the males with complete driver education courses had a superior performance only with respect to violation incidence. The Jones thesis found that the males who had complete driver education courses had significantly fewer accidents at the 1-percent confidence level over the males with classroom driver education only. Both studies found that the completely trained female drivers had a record superior to the females trained only in the classroom.

A summary of the official, semi-official, and graduate local studies is given in Table 11.

[70] American Automobile Association, *op. cit.*, p. 11-12.

Conclusions and Recommendations

Evaluations of driver education by a comparison of the records of trained and untrained drivers have been the subject of 14 studies of state programs and 14 studies of city programs.

The following generalizations may be noted from a review of 26 of these studies:

1. Most of the studies have found that the drivers who are graduates of a high-school course in driver education have fewer accidents and violations than drivers with no formal high-school course in driver education.

TABLE 11.—PERCENT OF SUPERIOR OR INFERIOR PERFORMANCE OF TRAINED DRIVERS IN REGARD TO ACCIDENTS AND VIOLATIONS AS FOUND BY ELEVEN LOCAL STUDIES

Studies	Accidents			Violations		
	Male	Female	Total	Male	Female	Total
1	2	3	4	5	6	7
Official or semi-official						
Bay City	[a]	[b]	—	41.3%	[b]	—
Bloomington	57.9%	72.8%	—	[c]	[c]	—
Camden	—115.0	[b]	—	—48.3	[b]	—
Cleveland	48.0	[d]	—	16.5	[d]	—
DuBois	[a]	[e]	—	53.0	[b]	—
Racine	73.3	56.2	—	59.3	52.0%	—
State College	[f]	[f]	77.8%	[c]	[c]	[c]
Theses						
Salt Lake City	39.4	45.6	40.3	41.2	55.3	42.7%
(Anderson)						
Salt Lake City	32.4	—	—	27.9	—	—
(Bushman)						
Olympia	47.9	66.7	51.6	41.4	66.7	42.7
Pueblo	29.2	23.3	27.0	41.5	36.8	40.3

Source: Official and semi-official studies are reported in *Driver Education Proves Its Worth*. Washington, D. C.: American Automobile Association, 1955. 28 p.

a. No accidents reported for the trained drivers.
b. No accidents or violations reported for the trained or untrained female drivers.
c. Study did not include violations.
d. Differences between records of trained and untrained females were deemed insignificant.
e. No accidents reported for the untrained drivers.
f. Separate figures not given for males and females.
Thesis studies are listed in the Appendix.

The evidence presented in this report may be regarded as conclusive.

2. The amount of superiority shown for the trained drivers varied greatly among the studies. However, the studies which appear to have controlled a maximum of variables have found for trained males a superior performance of 30 to 50 percent for the initial period of driving. The exact percent does not seem as important as the fact that it consistently reflected superior performance.

3. The drivers who completed a course in classroom and practice driving instruction generally were found to have a better record than drivers whose course was limited to classroom instruction. The evidence here is strong.

4. It appears that the salutary effect of driver education is most evident in the early stages of driving. As experience increases, the performance of the trained and untrained drivers tends to equalize. Further investigation of the lasting effect of driver education is needed to establish generalizations in this area.

The necessity for further large-scale investigation of the records of trained and untrained drivers on the same level of investigation is not indicated by this report. The evidence presented herein well establishes the merits of driver education. However, local studies may always be useful for the purposes of local promotion and evaluation of the driver education program. The following suggestions are presented as guides for future studies:

1. The research worker should possess thoro knowledge of the laws and practices of apprehending violators, reporting accidents and other traffic infractions, and the relative incidence of respective infractions.

2. The initial separation of the records of males and females is important.

3. The matching of male trained with male untrained drivers and female trained with female untrained drivers should be simultaneous with regard to age, educational achievement, driving exposure, urban-rural residence, and other factors. Machine selection or pairing of individuals is indicated.

4. The differences observed between the trained and untrained groups should be tested statistically to determine if the observed differences are significant.

5. The report of the study should include a description of the procedures of sample selection and the statistical procedures in sufficient detail to enable the reader to repeat the experiment.

6. There should be an exploration for new statistical technics more appropriate to this type of research.

7. Consideration should be given to establishing criteria of driver behavior which rest upon some other bases than violations and/or accidents. It is possible that observable designated "safe acts" might become the unit of measure of such an instrument.

VII. SUMMARY AND CONCLUSIONS

This report was organized as a critical analysis of existing and current studies as to the effectiveness of driver education programs in secondary schools. It was assumed that such an analysis would be of value to teachers and administrators in planning or continuing programs of traffic safety education. In addition, it was hoped that there might be derived therefrom more generalized implications relating both to the problems of general education and to the more special interests of educational research workers.

In order to reach this goal, certain steps were taken and certain procedures followed. Section I defined the problem and outlined the genesis of the project. Also, the data-gathering procedures and the limitations of the report were discussed. Section II summarized the research on the problem of youth and accidents. Previous analyses of driver education research were presented in Section III. Section IV outlined problems in experimental design. In Section V the studies were classified and discussed in terms of how they met the problems of experimental design, and in Section VI the studies were presented. Each section was summarized. However, from a consideration of these separate summaries there emerge further items in the nature of summary, conclusions, and recommendations. These follow.

The Problem of Youth and Accidents

There is conclusive evidence that youth is an accident-prone time of life. While the teen-ager's actual involvement in accidents is less than that of the group over 20 years of age, so is his exposure.

Despite the controversial nature of accident proneness there is no questioning the fact that some individuals are accident repeaters. The presence of a concentration of possibly unidentified accident repeaters in a group of drivers under study poses a problem in research design that existing technics may not be solving.

The extent of youth's accident involvement and research findings about the personality structure of the accident repeater combine to present a tremendous challenge to the educator. There is an overwhelming inference that the devising of a truly effective program of driver education is no simple, cut and dried matter. All of the problems of education are here as in a microcosm. The need for a driver education that sticks is tremendous. Moreover, the significance of the deeply rooted nature of the accident repeater's personality and behavior problem may have been overlooked. It would be well if safety educators and guidance personnel on all levels of education organized for a cooperative attack on the problem. There is in such a direction a potential for a significant reduction of accidents which cannot be accomplished if the accident repeater is known mostly by his presence in the viceprincipal's office and not at all thru his participation in a driver education course.

Previous Critical Analyses of Evaluative Research

Before this report was written, several agencies endeavored to evaluate driver education research. All these analyses agreed that the face value of the studies was favorable toward the thesis that driver education had accident-reduction worth. However, they differed as to whether the accident-reduction case had been proved. Also, there was variance as to the need for more research of the same general type in order to prove the case. In each instance—and this is true of this report, too—these analyses should be evaluated in the light of the type of organization undertaking the project and the purposes of that organization.

These projects in their entirety are valuable contributions in the field and should be studied critically by workers in traffic safety education.

The Problem of Experimental Design

The problem of experimental design transcends, and perhaps supersedes, any other question raised in this report. In Section IV there was an extended discussion of criteria for experimental design. It was emphasized that these criteria were interrelated. Questions were raised as to the reliability of basic accident data and as to optimum sample size. The inadequacy of statistical treatment was cited. An attempt was made to support the idea that a controlled univariate experiment in the social science field is an incredibly delicate and subtle matter of design and execution. And it is a design that may contain an inherent predisposition toward failure. In a culture which follows, tho slowly, the progress of the physical sciences and takes their methods as models for scientific inquiry, it is only natural that the controlled univariate experiment should have been appropriated for the social sciences. It is apparently not so well known that for the last 50 years these same physical sciences have been abandoning the concept of causality which postulated that particular kind of cause-effect relationship which permitted a univariate design. Causality in the physical world is now treated as a statistical concept about trends in a multivariate universe.

The possibility must be faced that the univariate experiment is passé in the social sciences. Complex tho the swirl of atoms may be, so is the concatenation of processes that determine that a particular person at a particular spot and on a particular day will have a motor vehicle accident. Consequently, if new experimental designs and statistical technics are necessary to render some explanation of the processes of the physical world, may they not be necessary to measure so complex a human activity as traffic behavior?

This stage of this report may seem contradictory. Why set up criteria by which to judge the studies and then condemn the criteria? The answer is that the studies had to be judged in terms of the traditional design which they accepted. Now the time is here to question the design.

Logically this question might have been raised some time past. Historically it was not. This is understandable. In a period of zeal to promote and justify a program it was easy to overlook the great distance between a study of teaching fractions by two different methods and an attempt to measure the behavior of two groups of drivers and isolate the factors bearing upon any differences in behavior. But to continue naive research at this period in the development of traffic safety education would be difficult to justify if there could be the widest possible effort made to *disseminate a knowledge of the research already completed and the findings, limitations, and implications of that research.*

There is also the possibility that traffic education research which attempts to compare driver groups will soon be facing a kind of technological unemployment. As driver education courses are extended to accommodate *all* eligible high-school students, no untrained groups of comparable nature will be available.

How the Studies Met the Problem of Experimental Design

The studies met the frustrating problem of experimental design practically in the procedural order of their classification for this report: (a) simple trend studies, (b) comparative studies which did or did not attempt matching of control and experimental groups but which had no statistical correction for significance of reported differences in performance, and (c) studies which had elaborate technics for simultaneous matching and conventional statistical correction for significance. By and large their chronological order matches this classification order. One is tempted to say that they have gone down the avenue of greater rigor into the blind alley

predicated by univariate experimental design. And yet each study was designed for a situation and a need and had to meet that need, expedient tho it often was.

What the Studies Show and Imply

The studies show indisputably that those who have had driver education have better driving records than those who have not had driver education. The extent to which this particular educational experience was causal—and, hence, established a relationship between the two groups—has not been so clearly defined. This, in turn, probably has not been the fault of the program or of the studies but of the real limitations inherent in this type of research.

The more rigorously a study has matched or controlled the driving groups being compared, the smaller have tended to be the differences in performance. But this difference remains. On the gross level it is empirically justifiable to say that traffic safety education has accident-reduction value. The extent of this reduction is indeterminate and will alter with local circumstances and thru time.

The driver education program in the secondary schools of the United States operates within a cultural context of traffic safety education. This larger program thru a variety of devices has steadily involved an increasing emphasis on public traffic safety education, law enforcement, and highway improvement and construction. It is this program—or some totally mysterious force—which has reduced the nation's fatality rate per 100,000,000 vehicle miles from 16.7 in 1934 to 6.4 in 1955. This, in a time of vastly increasing world tensions, is a notable achievement. In addition, there is no way to know what might be the irreducible minimum for accidents within the culture of this country. For it is a culture which stresses competition (and hence aggravates the need for adventure), which prolongs the processes of maturation of the young and their assumption of responsibility, and which perpetuates a kind of pioneer anarchy in which each man feels impelled to judge for himself the equity of a particular law and his culpability under that law as he reads it to himself.

The difference in performance between the driver who has been educated and the driver who has "just learned how" tends to become less over a period of time. Initially, driver education seems to have a salutary effect. The problem is to keep education ahead of the culture, particularly the age group culture of youth.

Conclusion

The evidence of this report shows clearly the extreme difficulty of scientifically measuring so complex and complicated a phenomenon as driving behavior. At the same time, the contention that a traffic safety education program reduces accidents is a plausible one. Therefore, more practical advances in driver education might come thru diverting research energy, talent, and money into ways of improving the existing program of instruction and, concurrently, into a program of research directed toward acquiring a better knowledge and understanding of those human factors—culturally operative—which create accidents. If a program of driver education is to succeed in changing behavior, it must be based on a better knowledge of how behavior develops and how behavior may be changed.

This report is again, on the surface, contradictory. The burden has been that the present studies are inadequate scientifically, that new and unused technics must be developed to prove the case. Now it is inferred that the case has perhaps been proved after all.

This is not a major contradiction. The vast experience of the American people in mass education has been that a good school teaches better than a poor school and a poor school better than no school at all. On this empirically derived feeling, free public education exists. The curriculum of the school

is determined by a feeling for, or an awareness of, those things which are of most worth. It is culturally determined. Traffic safety education is a demonstrated and expressed cultural need. But just as no school may go far ahead of those standards set by the society which creates it, so may no program of safety education run far ahead of the safety practices of the complex, sustaining cultural milieu.

APPENDIX

The following table summarizes the information concerning the state or local jurisdiction covered by the study, the date, and the agencies responsible for the study.

State or local jurisdiction	Date study was reported	Agency or agencies responsible for report
State-wide studies		
Arizona[a]	1946, 1949	Arizona Highway Department, Traffic Safety Division
Delaware[b]	1955	State Department of Public Instruction, Dr. Robert C. Stewart, Assistant State Superintendent in charge of Secondary Schools
Maine[b]	1955	State Department of Education, Howard G. Richardson, State Director of Physical Education, Health, and Recreation
Maryland[a]	1951	Traffic Engineering and Safety Department, American Automobile Association
Massachusetts[b]	1955	Registry of Motor Vehicles, Rudolph F. King, Registrar
Michigan[a]	1950	Automobile Club of Michigan
Minnesota[b]	1954	State Department of Education, J. G. Neal, Supervisor of Health, Physical Safety and Recreation Education in cooperation with the Drivers License Division, Department of Highways
New Hampshire[b]	1951	State Motor Vehicle Department, Ralph V. Gould, Director of Safety
New York[a]	1950	Automobile Club with cooperation of Bureau of Motor Vehicles and local school officials
Oregon[c]	1954	Secretary of State and State Department of Education, State Supervisor of Driver Education
Pennsylvania[b]	1952	State Departments of Public Instruction and Revenue
Vermont[b]	1952	State Motor Vehicle Department, H. Elmer Marsh, Commissioner
Virginia[b]	1954	Mutual Insurance Rating Bureau and National Bureau of Casualty Underwriters
West Virginia[d]	1952	Division of Financial Responsibility of the West Virginia Department of Motor Vehicles. Reported by Clarence A. Brock, Assistant State Supervisor of Administration, Department of Education
Wisconsin[a]	1951	Master's Thesis, University of Wisconsin
" [a,e]	1945	State Department of Education
Local studies		
Akron, Ohio[a]	1953	Akron Public Schools, W. L. Neuenschwander
Arlington Heights, Ill.[f]	?	Police Department
Bay City, Mich.[a]	195-	?
Bloomington, Ill.[a]	1950	Bloomington School District

Camden, N. J.[a]	1950	?
Cincinnati, Ohio[a]	1952	Department of Research, Cincinnati Public Schools
Cleveland, Ohio[b]	1945	Traffic Engineering and Safety Department of the American Automobile Association in cooperation with city schools and city police, and State Motor Vehicle License Department
Du Bois, Pa.[a]	1952	American Automobile Association
Keokuk, Iowa[f]	1955	Keokuk (Iowa) Police Department
Racine, Wis.[a]	1950	Dr. George W. Walter, Racine Public Schools
State College, Pa.[b]	1939	Amos Neyhart, Institute of Public Safety, Pennsylvania State University (based on thesis of graduate student Richard Einseman)
Stillwater, Okla.[a]	1951	Local Police Department
Toledo, Ohio[b]	1950	Toledo Public Schools, Safety Education Department

SOURCES OF INFORMATION:

a. AAA. *Driver Education Proves Its Worth.* 1955.
b. Access to report of study.
c. Reported by Department of Research and Measurements, Portland Public Schools.
d. Letter from official associated with study.
e. Accident Prevention Department, Association of Casualty and Surety Companies, *Research on Accident Reduction Value of High School Driver Education*, June 1955.
f. From files of National Commission on Safety Education.

DRIVER EDUCATION EVALUATION STUDIES BY CANDIDATES FOR ADVANCED DEGREES

Available for Report:

ANDERSON, H. NEIL. *Study of the Driving Records of High School Graduates Who Have Completed a Driver Education Course as Compared to Graduates Who Have Not Completed a Driver Education Course.* Master's thesis. Salt Lake City: University of Utah, 1952. 77 p. (Typewritten)

BUSHMAN, H. KEITH. *A Comprehensive Study Evaluating Driver Education in the Senior High Schools from Analysis of Driving Records of Salt Lake City High School Students.* Master's thesis. Logan: Utah State Agricultural College, 1954. 52 p. (Typewritten)

HARDESTY, PAUL R. *A Study of Accidents and Violations in Relation to Behind-the-Wheel Training.* Master's thesis. Terre Haute: Indiana State Teachers College, 1953. 50 p. (Typewritten)

JONES, WALLACE A. *The Accident Record of Trained Drivers and Untrained Drivers.* Doctor's thesis. Palo Alto: Stanford University, 1952. 73 p. (Typewritten)

PINSON, LAWRENCE GALE. *An Evaluation of the Driver Education and Training Program in the Olympia, Washington, High School.* Master's thesis. Corvallis: Oregon State College, 1954. 81 p. (Typewritten)

SMITH, DOYLE J. *A Comparative Study of Accident and Violation Records of High-School Trained and Non-High-School Trained Drivers in Pueblo, Colorado.* Master's thesis. Colorado Springs: Colorado College, 1954. 79 p. (Typewritten)

Unavailable for Report:

COMA, ANTHONY S., JR. *An Evaluation of the Driver Education Program at the Edward Bok Technical School.* Master's thesis. Philadelphia: Temple University, 1955.

LINDEMAN, RICHARD H. *A Comparison of the Effectiveness of Two High School Programs of Driver Education.* Master's thesis. Madison: University of Wisconsin, 1951.

MARSHALL, ROBERT LOGAN. *A Comparative Investigation of Trained Drivers of the El Dorado, Kansas, High School and Those Drivers with Less or No Training of the Arkansas City, Kansas, High School.* Master's thesis. Wichita: The Municipal University of Wichita, 1956.

WATNE, GERALD C. *A Descriptive and Evaluative Study of Driver Education in Colorado High Schools.* Doctor's thesis. Denver: University of Denver. (Status of study unknown.)

State and Regional Studies in Process or Proposed:

Connecticut—Study released by Department of Motor Vehicles too late for analysis in text of report. Shows marked superiority of trained group. However, male-female proportions of groups is not indicated.

Detroit—Research design involving all Detroit High Schools proposed in 1954. No action reported.

Florida—Study by State Department of Education in process.

Iowa—Study by Department of Public Safety reported in process.

Missouri—State study by Robert Sonderman, University of Missouri doctoral candidate, in process.

Pennsylvania—Study planned by State Department of Public Instruction.

Erie, Pennsylvania—Study reported in process.

Los Angeles—Studies in process measuring performance of drivers with classroom instruction only, compared with completely trained drivers.

New York City—Study by Bureau of Research (Board of Education) in process.

South Carolina—Study planned by Department of Motor Vehicles.

South Dakota—Study by South Dakota Education Association reported in process.

Virginia—Study by State Department of Education reported in process.

(10M-12-56)

"Tips" and "Cues"

HOW EXPERIENCED TEACHERS DEVELOP GOOD TRAFFIC CITIZENS

Prepared by the
NEA Research Division
in collaboration with the
NEA National Commission
on Safety Education

National Commission on Safety Education
National Education Association
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Teaching correct and safe right- and left-turn maneuvers

Teaching precision maneuvering in close quarters

Teaching parallel parking

Teaching students the technics of driving in city traffic

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Teaching students how to pass other cars with safety and courtesy

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Developing an awareness in beginning drivers that most accidents can be prevented if drivers are alert to potential accident situations and make the proper compensating maneuvers

Teaching students the concept of safe speeed, including the need to adjust driving speed and visual attention to changing road conditions

Developing habits of awareness to danger spots

Aiding the student to form habits of recognizing when another driver, pedestrian, or cyclist is creating an accident situation

Preparing students to drive under hazardous conditions, such as on icy or slippery roads, thru rain, snow, fog, high winds, etc.

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FOREWORD

This report is the third in a series of cooperative studies in traffic education by the NEA National Commission on Safety Education and the NEA Research Division. It was preceded by *Research Needs in Traffic Safety Education* and *A Critical Analysis of Driver Education Research.*

It is a primary function of the National Commission on Safety Education to encourage better and more comprehensive instruction in safe living. But this is not a function that may be carried out in isolation. Only in the living situations of the on-the-job educator may instruction be planned, tested, varied, re-tested, and organized into tangible gains.

Consequently, it is a privilege for the Commission to be able to tap the fresh and vigorous field of driver education for instances of successful practices and to organize this material and return it to people in the field.

Jean Flanigan, Senior Research Assistant, was responsible for the original draft of the manuscript. Members of the Commission staff prepared the final copy.

The driver educator is an enthusiastic teacher. No matter how he may have grown into his job, he continues making himself a better teacher. You will find him haunting summer sessions, seminars, workshops, conferences, and informal discussions on traffic safety. Invariably he is staying in this particular teaching assignment because he has seen a need and a chance to do something about it.

He has probably the most challenging—and frustrating—and satisfying job in education! And, paradoxically, he pushes hard at expanding those limits.

He believes that his teaching is important. (His community believes so, too.) Having worked thru some of the ins and outs of the nation's traffic problems, he is convinced that in education lies the greatest hope for changing driver behavior. And so he's proud to be identified with it.

He likes the scope and variety of his teaching. Where else could there be such a happy place to put together and apply so many vital ideas from the main stream of general education? Where better could a teacher take significant concepts and attitudes, weave them together with carefully developed neuro-muscular skills, and come out with the living expressions of good citizenship?

The very uniqueness of driver education helps as it challenges. Motivation to learn is of the highest order. Can't we all remember when our chance to drive a car was in itself a suitable reward for living?

That dual control car is *one* American classroom with a low, low pupil-teacher ratio. It is a laboratory for combining skill teaching with judgment development, for guiding the application of on-the-spot counselling.

Adventure? It's there, too — in the kaleidoscope of city traffic, in the changing countryside, in the

motion, in the anticipation of what may arise. And in teaching a pupil how to meet and master a variety of situations.

This means that self-discovery is part of the lure. Somebody has said that the really significant learnings are self-discovered and self-appropriated. Well, as a young driver moves from "I see myself as one who can't" to "I see myself as one who can" his teacher moves along, too. Here is another to whom he may point and say, "I saw him grow before my eyes."

Yes, driver education teachers love their work. Of course they have their struggles — to make their chosen field "respectable," to win sometimes grudging status from their colleagues, to gain more administrative support, to overcome scheduling difficulties, to get the dual control car soon enough and keep it long enough.

And there are still broader concerns. How to keep pace with a fast-breaking educational front. How to keep the teaching alive. How to ward off subject-matter ossification. How to keep in sharp focus the idea that here is a cause deeply rooted in the needs of modern society.

Some of these teachers meet on the pages of this report. They bring their ideas, their technics, their procedures, their know-how. Shop talk? Perhaps. But we think you'll enjoy it.

I. INTRODUCTION

Origin of the Report

This study was undertaken in response to a demand for a survey to obtain from experienced teachers of driver education a narrative or anecdotal type description of teaching methods which would add vitality and meaning to the conventional lists of technics or methods. The need for such study was expressed by authorities working in safety education and by teachers of driver education in both the colleges and the high schools thruout the United States. The Research Advisory Committee of the National Commission on Safety Education chose this survey as the first in critical need among a list of 36 survey type studies. It was rated fourth in critical need among the same list of studies by 944 teachers in colleges and public schools.[1]

Purpose

The report is an initial attempt to compile anecdotal descriptions of how teachers teach, in such a way that the new teacher or student teacher will gain some insight into what is required of the teacher of driver education, what is taught, how it is taught, and the peculiar problems the driver educator faces.

For the experienced teacher, the purpose of the study is to stimulate the evaluation and refinement of the procedures he is using. The report should serve as a source of new ideas, to provide points of departure. It is recognized that what works in one teaching situation may not work in another due to such intangibles as the personality and experience of the teacher, the class, and the individual student. Not all the ideas presented here will be judged superior by the reader. Many of the ideas will perhaps be modified and adapted to meet a reader's own teaching situation. Thus, the report is in no way a prescription for teaching driver education.

Procedure

In April 1956 a request was sent to 1482 experienced teachers of driver education thruout the United states. The covering letter said, in part, "We are asking you to describe technics in teaching driver education which you have used successfully and would like to pass along to other teachers. We are interested in how you teach—technics you use to guide the development of a non-driver or a faulty driver to a competent driver." The assumption that the respondents would contribute original technics, as well as tested procedures from the "public domain" of traffic safety education, was inherent in the request.

A list of 44 topics — designed to suggest problem areas — accompanied the letter. From this, the recipient was asked to write at least three descriptions on topics which were of interest to him and which he felt he had handled well. Forms for the reply and a stamped return envelope were also provided.

The report which follows is based on the materials from the 156 teachers who replied. They are to be commended. The task they were asked to perform was unusual. Instead of checking off a conventional list of questionnaire items they had to evaluate, select, and then write-up — often in great detail — specific descriptions of teaching situations.

The Respondents

The average teaching experience of the respondents was 5 4 years. Almost all reported that they

[1] National Education Association, National Commission on Safety Education. *Research Needs in Traffic Safety Education.* Washington, D. C.: the Commission, 1956. 20 p.

had had professional preparation in driver education. Ninety percent of them taught both the classroom and practice driving phases of the course in large and small urban and rural school districts. All but one of the respondents were males.

Methods of Instruction

The National Conference on Driver Education in 1953 concluded the following concerning methods of instruction in driver education:[8]

> Except with relatively inexperienced teachers, little attempt should be made to regulate methods closely since their use must vary according to student needs, size of group, type of learning experience, ages of students, teacher abilities, available facilities, daily purpose, organization of school or program, and other local conditions . . .
>
> It is essential that each instructor be skillful in a variety of teaching methods and technics, and that he plan for the appropriate use of:
>
> 1. class discussions
> 2. teacher presentations
> 3. visiting specialists and resource persons
> 4. classroom forums and panels
> 5. audio-visual resources (e.g., recordings, motion pictures, filmstrips)
> 6. skill-developing and psychophysical exercises, devices to simulate driving, "mock-ups," and comparable aids to supplement basic instruction
> 7. community projects (e.g., surveys, interviews, traffic checks)
> 8. demonstrations (e.g., skills for use in emergencies, laws of nature related to driving)
> 9. drills, in meaningful settings, to develop manipulative skills
> 10. field trips to traffic courts, highway departments, driver licensing bureaus, and garages
> 11. dramatizations and role playing
> 12. group discussion projects involving action commitments
> 13. cooperative problem-solving projects
> 14. participation in community and statewide safety conference
> 15. evaluation of a cooperative and continuous nature.

[8] National Education Association, National Commission on Safety Education. *Policies and Practices for Driver Education.* (Developed by the National Conference on Driver Education held at Michigan State College, East Lansing, November 15-18, 1953.) Washington, D. C.: the Commission, 1954. p. 15-16.

II. TEACHING THE BEGINNING DRIVER THE SOCIAL RESPONSIBILITIES OF DRIVING

> Every fact learned about the traffic accident problem strengthens the conviction that this problem goes deep into behavior and social customs, practices and attitudes . . . the reality is that few other social problems have as many divisions as well as so many vested interests to combat, be these interests economic, social, or in the realm of individual action.[8]

Each driving experience is an experience in citizenship. In no other activity are we so acutely aware of laws. Constantly we are exercising our individual responsibilities to other drivers and pedestrians. Almost every action of a driver is governed by a law, or a rule of safe driving with the status of law. His adjustment to the social and legal responsibilities of driving often determines whether he will continue to drive.

Developing the Student's Ideas of "Traffic Citizenship" as a Part of All Good Citizenship

Implicit in the responses was an awareness that teaching traffic citizenship is fundamental in high-school driver education. Traffic citizenship includes respect for the privileges and rights of other drivers and pedestrians, and an extension of good sportsmanship and desirable social behavior to driving. Teachers introduce this subject early in the classroom part of the driver education course and it is referred to continually in the teaching of all other units both in the classroom and in the practice driving car.

Relating "traffic citizenship" to citizenship — In teaching traffic citizenship, a teacher may enrich the instruction by recalling to students lessons they have already learned about citizenship and an individual's responsibilities from other areas of the curriculum. Conversely, he may point his instruction in such a way that a student's development in traffic citizenship is also reflected in and contributes to his development in general citizenship.

One teacher introduces this subject by guiding the class thru an analogy between the privileges, rights, and limitations of United States citizenship and the privileges, rights, and limitations embodied in the driver license. His students are already familiar from their social science classes with the concept "one citizen's liberties end where the possibility of infringement upon another's begins." They also know the conditions under which an individual can lose his citizenship. The discussion develops the student's knowledge of the status of a permit to drive, i.e., it is a privilege which can be taken away if it is abused. This procedure both uses and contributes to their understanding of general citizenship.

Timing the instruction — Some teachers and authorities on traffic safety education have said that traffic citizenship instruction should begin early in the elementary grades. One teacher outlined the specific assistance he gives to elementary classroom teachers to encourage them to teach traffic citizenship. Visual materials made or obtained for the driver education class are passed along to elementary teachers. Some examples are traffic signs, traffic lights, and models of inter-sections and highways. Another technic is to have a highway patrolman go to elementary classrooms during his regular visit to the driver education class.

Another teacher has found that the instruction is more appropriate if the driver education course is

[8] Leon Brody and Herbert J. Stack, editors. *Highway Safety and Driver Education*. New York: Prentice Hall, 1954. 464 p., p. 43.

timed to capitalize on the enthusiasm of boys and girls as they approach the age of eligibility for their driver licenses. Teen-agers respond to this event with dynamic interest. This is the best time to stress the principles which are embodied in this document that permits one to drive a car.

"On the Spot" teaching — Several teachers suggested that "On the Spot" teaching in the practice driving car was most significant in developing the attitudes of a good traffic citizen. One stresses traffic citizenship first in the classroom discussion. The first four driving lessons deal with the technics of manipulating the car. By the fifth lesson, the students are driving in traffic. Here the lessons of good sportsmanship are put into practice. This teacher observed that, in the practice driving phase of the course, as in no other class in school, it is easy to teach fair play thru courtesy because practical situations are present. For example:

> The teacher directs the students' attention to the failure of one driver to yield to another driver who is already in the intersection and is signalling for a left turn. The students observe the congestion in both lanes of traffic. When the driver education car yields the right of way the students observe that in only a few seconds the traffic is moving again in both directions.

Another teacher stresses traffic citizenship from the first lesson in the practice driving car. At the initial meeting of the driving group, he tells the students that the objective "to learn how to drive" is important but secondary to the objective "to become good traffic citizens." At every opportunity thruout the course, situations are used as they arise while driving to illustrate the accident potential of traffic violations and unsportsmanlike behavior. The proper action to take is always discussed with the group. This is done by (a) stating the goal — to become good traffic citizens; (b) showing by observed examples of other drivers how a dangerous situation developed or was avoided; and (c) when a bad situation was observed, having the students point out what could have been done to avoid the situation. Thus they observe that the actions which could have avoided the situation always may be classified as observance of traffic rules and laws or as sportsmanlike behavior.

Relating traffic behavior to social behavior — Teaching "motor manners" is a major part of one teacher's practice driving course. His class is told, "Take your best personal manners with you when you get behind the wheel." The specific problem attacked in this instruction is to overcome the feeling that some drivers have in a car — isolation from social communication with other drivers. Accordingly his students are taught the signals for courteous communication with other drivers. They learn how to say "thank you" by tipping the hat, waving the hand, or tapping lightly on the horn and experience the personal satisfaction which results when their courteous acts are recognized.

A courtesy project — One driver education class developed a project which raised the standard of courteous behavior for the entire student body. As part of the regular classroom program, they viewed a film which develops the theme that on the highway "courtesy is contagious." The class decided to enlist the entire student body (approximately 1000 students) in a courtesy project. Basic to the project was the idea that if a person is courteous in the hallways, the classroom, and on the athletic field, he will be courteous on the highway. It was developed as follows:

> Students in the radio club made tape recordings of the noise in the lunch room; photography club students made candid shots of discourteous acts in the hallways; then an evening meeting in the school auditorium was planned for the officers of every organization and homeroom; the nature of the meeting was kept highly secret; and the invitations were sent in the form of a "summons."
>
> To start the meeting a tape recording was played which pointed out that the students were behaving this evening like ladies and gentlemen. (The only faculty member present was the driver education teacher who was in another room waiting for the appropriate time to take part in the meeting.) A voice on the tape recording asked: "What makes these same people act one way on one occasion and in a different way at another time?" As a suggested answer, the film was shown.

Then the driver education teacher appeared and reviewed the purpose of the meeting. He reminded the students again of their excellent behavior earlier that evening. Next the tape recordings and the candid photographs were presented to show the other side.

The reaction of the students was good. The meeting was divided into small groups headed by members of the driver education class to discuss methods for attacking the problem. Many suggestions resulted. The officers of each organization present agreed to support the projects by sponsoring individual projects. In the following weeks homerooms, clubs, teams, and the faculty sponsored courtesy projects. The driver education classes acted as the coordinating agency for the dances, tag days, and the like that were promoted.

The respondent who submitted the description of this project concluded that this high school can honestly say that "courtesy is contagious." It worked in the hallway as well as on the highway. His project shows how the lessons learned in driver education can be fortified and at the same time extended to improve the behavior of the whole student body.

Using the findings of research — One respondent has used this quotation as a point of departure for high school and college class consideration of the responsibilities of traffic citizenship:

> You can tell the measure of a person by the way he drives. If he shows consideration for others, heeds the signs and signals, observes the rules of the road, you may be sure he is a good citizen—a good American.
> Anon.

The discussion which follows develops the theme "A man drives as he lives." His students are very interested in the findings of research on the psychological and social background of accident-free and accident-repeater drivers. The studies this respondent mentioned were:

Dennis, W., "Differential Social Characteristics of Convicted Automobile Drivers," *Psychological Principles in Automobile Driving*. Columbus, Ohio: Ohio State University Press, 1930. p. 114-130.

Tillman, William A. and G. E. Hobbs, "The Accident-prone Automobile Driver: A Study of the Psychiatric and Social Background," *Journal of Psychiatry*. 126:321-331; November, 1949.

Van Lennep, D. J., "Psychological Factors in Driving," *Traffic Quarterly*. 6:483-498; October, 1952.

Many other research studies also have developed the theme "A man drives as he lives."

Summary — The descriptions of procedures in this section show that teachers are using a variety of technics in both phases of the course to develop good traffic citizens. These include relating traffic citizenship to United States citizenship, timing the instruction, "On the Spot" teaching, and relating social behavior to traffic behavior. In the practice driving car, teachers are providing students with learning experiences in courteous behavior. Of particular interest here is the emphasis driver education teachers are placing on the relation between traffic citizenship and general citizenship, between traffic behavior and social behavior. These teachers see the automobile as one of the best instruments our society has for teaching good citizenship.

Developing Knowledge and Habits of Observance of Traffic Laws and Safe Driving Roles

Two related problems are involved in developing knowledge and habits of observance of traffic laws: how to convince students that laws and rules are necessary; and how to help students acquire the correct judgments and maneuvers required by the laws and rules.

Using "traffic posters" — One respondent, having found that the word "rules" has an undesirable connotation for many young people, introduces the topic to his class with the question: "Why are rules necessary in any activity which involves two or more people?" This stimulates a lively discussion which ends with the teacher's summary: "Rules promote efficiency, economy, and enjoyment." His next step is to have the class suggest some important rules in driving. These are written on the blackboard. As homework for the next class meeting, students look up the rules in the vehicle code. The assignments are on a volunteer basis with one student responsible for one rule or law.

At the next class meeting, each rule is presented in the form of a "traffic poser." A student demonstrates a traffic situation covered by the rule he has chosen using a magnetic board and model cars for the demonstrations. Each student has prepared four possible answers to the poser he is demonstrating and asks the class to select the correct answer. This instruction does much to help students see the need for traffic laws and to learn the laws and the best methods of applying them. Simulating traffic situations with the magnetic board and model cars adds realism to the instruction.

Demonstrating traffic laws in the practice driving car — One teacher distributes copies of the state and city traffic codes. After the students have studied the codes, they are taken thru town in the practice driving car while pertinent laws and regulations are discussed and demonstrated.

Traffic behavior surveys — Several teachers reported that they had students make surveys of actual traffic behavior in the community after they had studied the laws and safe driving practices. The amount of time spent making traffic behavior surveys depended on the concentration of traffic at the location under observation. A teacher from a large city said that observation of from five to 15 minutes is all that is necessary to give a student an indication of the proportion of drivers who may be expected to violate laws.

Another teacher has mimeographed cards to facilitate checking the violations. Five common violations committed at intersections are listed so that a student can easily record what he observes without taking his eyes off traffic very long. The card also allots space for identifying the intersection, the time, and the number of cars entering the intersection. These observations are made as individual, group, or class projects.

Summary — The descriptions of teaching procedures submitted on this topic indicate that teachers are using a variety of technics to help the student develop knowledge and habits of observance of traffic laws and safe driving rules. These include: traffic posers or socio-drama solved with visual aids; demonstrations in the practice driving car; and student observations of traffic behavior.

While most of the technics described here are for use in the classroom, practice driving instruction also provides many opportunities to evaluate and strengthen student understanding of traffic laws. Habits of observance to traffic laws may be established by always requiring the student driver to observe the law.

Developing Friendly and Cooperative Attitudes Toward Traffic Enforcement Officers and Traffic Courts

A teacher wrote: "I point out an officer of the law to the students in the practice driving car and say, 'He is your best friend.' 'You're kidding!' is the usual response."

The circumstances under which a motorist usually meets a traffic officer or appears in traffic court are not conducive to a driver's development of friendly and cooperative attitudes toward these officers. Furthermore, the legend of the tough cop and unsympathetic judge, tho inaccurate, has permeated the American motoring milieu. Even with the beginning driver, re-education and breaking down of prejudice often must precede the development of desirable attitudes. Traffic enforcement officers as well as driver education teachers are aware of this problem, and are working on it.

The traffic officer comes to class — The teachers who wrote on this topic agreed on the value of having a state or local traffic officer visit their classes. Meeting and talking with an officer does much to convince students that he is an ordinary man devoted to a worthwhile job. The cooperation of traffic officers with driver education teachers ranged from police speakers for classes and assemblies to active participation in specific phases of instruction and testing.

One director of driver education in a large city school district wrote of a well-organized program for classroom speakers from the city police depart-

ment's educational detail. The following procedures are used:

> A list of items to be included in the speech by the police officer plus a draft of a model speech were prepared by the director of the program and approved by the superintendent of schools and the chief of police. This, along with a schedule for the speakers, was mimeographed and distributed to the police officers and the driver education teachers. Speakers were scheduled well in advance of the visits.
>
> Prior to the day of the visit; a teacher is advised to outline to his students what they can expect to learn from the police speaker. They prepare three questions to be answered by the speaker in the last ten minutes of the class period. Afterwards teachers are asked to rate the policeman's presentation so that the program may be improved.
>
> One part of this procedure is particularly commendable—i.e., the practice of informing the police speaker in advance about the points which the teacher would like to have him cover.

This procedure is adaptable to small school districts where the local or state police department does not have an educational detail or an experienced speaker. Any speaker can profit from advance knowledge of the needs of his audience. How much guidance the teacher can give the police speaker depends upon the experience of each and the relationship between them. However, the responsibility remains with the teacher to insure that the experience will be a profitable one for the class.

A teacher in another large city school district wrote of a procedure whereby the policeman's visit becomes a class project. On the day of the visit, several students are elected to meet the speaker and to assume the responsibility for introducing him to the class. Most of the police officers come in plain clothes which, it is observed, has the effect of relaxing the students. (Other respondents indicated that the appearance of the officer in uniform was more effective.) This teacher stated that the police department in his city is working hard to gain the respect and cooperation of teenagers. Traffic officers have cooperated with youthful drivers in solving their driving problems. The effect of this work has been that the teacher's job of developing friendly and cooperative attitudes toward these officers is greatly facilitated.

Another teacher has three former students who are now state highway patrolmen. Each spends at least two class periods with this teacher's current classes. In talking to the class, these officers concentrate on what an officer tries to prevent—not on what he does to a violator. Because they are former students, a common bond exists between the class and the patrolmen. This teacher believes that the good attitudes his students have toward these patrolmen are extended to all traffic officers.

Several teachers wrote that they used the services of the police to assist in specific areas of instruction. In one instance, a policeman helps the teacher administer the brake reaction tests. In another, the police assist in the final driving test which is a part of the course. One teacher times the visits of the police speakers so that the topics they discuss coincide with the unit the class is studying. On the first visit the policeman discusses state and local traffic laws. On his second visit he discusses safe driving practices.

In addition to the police speaker, one teacher has his class view a film which features a state trooper.

Visiting traffic court — Several driver education teachers wrote that their classes visited a traffic court to observe the proceedings. In some cases the whole class went; in others, individual students or groups went and reported their experiences to the class. One teacher reported an exceptionally successful visit:

> After the court adjourned, the judge asked the students to remain. He discussed with them the cases he had just heard, his method of handling them, and his reasons for the course of action he selected. Frank questions were encouraged. The chief of police was also present and gave his point of view on questions the students asked.

Summary — Many teachers have police speakers

come to the driver education class and have the class visit traffic court. Judging from the responses to this topic, most teachers have found that these experiences helped develop friendly and cooperative attitudes toward police and traffic courts. This section has stressed the things that a teacher can do to make the project a successful learning experience for the students. These include how to prepare the class for the speaker and how to prepare the speaker to meet the needs of the class. Showing and discussing a film, and visiting traffic court have been judged as good learning experiences in developing desirable attitudes toward police and traffic courts.

Developing Safe Drivers in Situations Where the Student's Family and Friends Are Not Exemplary Drivers

One phase of this problem deals with the influence of the student's family and friends who do not know or do not use the correct procedures in driving. Another more serious phase is concerned with the examples set by the families' and friends' capricious attitudes toward safety, law, and responsibility. The influence of the driving behavior of the other individuals with whom the students are in contact and of the standards of the community operate to complicate the driver education teacher's task of developing safe drivers.

Explaining how driving has changed — One teacher takes the entire class to the main street of the town to observe other drivers making poor turns, beating lights, failing to stop behind crosswalks, etc. The class agrees that this is not the right way to drive. This "licks" part of the problem because students are now ready to learn the correct way. This teacher has found that many of his students explain the lessons learned in class to their family and friends. Still another teacher observed that most students are proud that they drive better than their parents.

Visual materials are used by one teacher to demonstrate how driving conditions have changed since parents learned:

> He uses a series of model cars representing the different periods in the development of the automobile. The exhibit is accompanied by a brief summary of each model's horsepower, speed, cost, type of road it traveled, and the number of cars on the road. The later models are compared with the earlier ones to emphasize the greater requirements and responsibilities of drivers today.

This demonstration impresses students with the fact that 1930 driving habits and today's cars do not mix.

Creating pride in being an "educated driver" — One respondent uses a procedure which in effect aligns his students with all other driver education students and supplants their affiliation with groups or individuals which do not take pride in safe driving. He reviews with the class the research studies which show that driver education students have a better driving record than youth of similar age and experience who have not had a course in driver education. Students are thus encouraged to feel proud of being a part of a group which maintains an excellent driving record.

Another teacher thinks that the key to this problem is in providing experiences for the student in which good driving results in personal satisfaction. In practice driving, he frequently calls a student's attention to the personal satisfaction which results when the student handles a situation well. The student's attention also is directed to the obvious frustration of other drivers who are not handling a situation well.

Handling peer group or clique influence — One teacher has noticed that a large part of this problem falls on girls who date and tend to idolize show-off drivers. Therefore, he allots time for his students to discuss accidents and near-accidents which are known to them. The teacher's role in this discussion is to focus attention on the attitudes and the violations which led to the accident situations. He has found in subsequent meetings of the class that the students are thinking about how their friends are driving, and that in many instances that have started working on their friends' driving attitudes.

Summary — Treating the show-off adolescent driver with ridicule and scorn may strengthen his conviction that his anti-social behavior is a good way for him to achieve recognition. Also, no good purpose is served by telling a child that his father is a poor driver. In dealing with this problem great care must be used to see that the instruction is not destructive of the relationships which already exist between the student and his friends and family.

A good understanding and mastery of driving is generally conceded to be the best defense a student can have in cases where the influence of his family and friends tends toward unsafe driving practices. In this problem teachers rely primarily on developing student awareness and understanding that safe driving now requires more than most untrained drivers are equipped to give; and that thru this course students are prepared to drive under modern conditions. Teachers are working to develop pride in safe driving.

The procedures which driver education teachers submitted on this topic offer specific suggestions on how to deal with this problem. They included: (1) projects designed to develop student awareness of poor driving behavior of other drivers; (2) the provision of experiences which result in feelings of personal satisfaction from safe and good driving; and (3) helping a student to identify himself with a group which has maintained a good driving record, i.e., driver education graduates.

III. TESTING AND IDENTIFYING ABILITIES, LIMITATIONS, AND PROGRESS OF THE STUDENT DRIVER

In driver education as in other subjects, tests are given to measure a student's achievement and progress and to stimulate his learning.

Such tests may be formal or informal, objective or subjective, or a combination of any of the foregoing. When a test is valid, the results indicate a student's progress. The results also show a teacher the worth of different teaching procedures and technics.

Tests of classroom and driving performance designed by teachers or available commercially appear to be adequate. In the area of testing and measuring attitudes and predicting driving behavior, however, the validity of existing pencil-and-paper tests is less well established.

Anticipating (By Tests, Observations, etc.) a Student's Probable Driving Record

When a teacher can recognize characteristics and tendencies that may cause traffic difficulty for the individual student, he can do much to help this student avoid a costly and perhaps fatal driving career.

Teacher observations of the pupils — One teacher observes his students carefully the first time they report to the car:

> He gives them the first few minutes to talk to one another. During this short unrehearsed period, he has found that a student reveals many clues to his attitudes toward driving by his actions and expressions as he approaches the car. Then the teacher has each student fill out a card with his name, address, and other pertinent information. In addition, he is asked to indicate if he has ever been in an accident or witnessed the occurrence of a serious accident. The students are informed that the purpose of the card is to help the instructor know each student personally. The cards are kept in the car for the first few weeks for the teacher to record his observations of a student's driving difficulties. These are entered in code as follows: (1) nervousness; (2) poor response to instructions; (3) tenseness; (4) poor mastery of reading lessons; (5) poor response to demonstrations; (6) emotional upsets; (7) thoughtless actions; (8) inability to do multiple actions simultaneously; and (9) not watching the road ahead. Each of the difficulties, when noted, becomes a personal challenge to this teacher to see if he can help that student make the required adjustments.

Relating negative special behavior to negative driving behavior — The experience of one respondent has been that psychophysical tests can not be used to indicate a student's probable driving record. While these tests indicate possible weakness in a student's ability with proper guidance he usually is able to make adequate compensation for most physical deficiencies. The probable driving record can be anticipated by the teacher's subjective evaluation of the student's behavior. The student who is egocentric, a show-off, or a rationalizer, is likely to manifest these traits in his driving. In the classroom this teacher guides students into a discussion of attitudes by encouraging them to tell of social experiences where these traits were obnoxious. Then parallels are drawn between egocentric social behavior and egocentric driving behavior. The discussion points out that such personality traits and safe driving are incompatible and that an individual's driving behavior can be anticipated by observing his personality manifestations in social situations. A student is encouraged to analyze his own personality and to recognize undesirable traits he may have. This teacher provides clues for self-analysis. In so doing he believes that he effectively instills in his students a determination to cultivate positive personality traits and to recognize and guard against those undesirable traits he may possess.

Informing the student of his potential success as a driver — During the last few weeks of the course one teacher has a conference with each student. At this time the teacher summarizes his observations about a student's general behavior, attitudes, and physical abilities and gives him a straight-forward estimate of his ability to drive.

Pupil-teacher conferencing is an emerging practice in secondary schools. It is designed to be a mutual evaluation of student progress rather than a disciplinary session. In many ways it resembles a counseling situation.

In counseling there is much current discussion concerning the merits of directive vs. nondirective methods of counseling. In a discussion of objective scores, such as psychophysical ratings and measured driving performance, the communication should be as direct and simple as possible. These are facts. However, when there is a need to discuss with a student the relationships which may exist between his attitudes and his exercise of driving skills, another tack may well be in order. In a zeal to have only good drivers, it is possible for a teacher to become hostile toward the student who "shows off" in his driving. Conferring with a student in a "no punches pulled" manner may have the equivalent negative effect of being bawled out by a police officer. Aggressive conferencing, needling, and the shock treatment are technics of questionable value. If the conference is to produce a salutary effect, a teacher must attempt to understand a student's feelings about himself and thru such an understanding guide him toward better attitudes toward driving.

Summary — The descriptions submitted on this topic are consistent with the recent findings of research. The distinction between potential accident-free and accident-repeater drivers is being made on the basis of general behavior—attitudes and acceptance of the responsibilities of maturity. However, most of the estimates of teachers have a highly subjective base. Recent research findings have suggested means whereby the teacher can confirm his evaluations. Tillman found a group of accident repeaters commonly associated with the following problems from childhood thru adolescence: Excessive strictness of parents and disharmony in the home; excessive childhood phobias; excessive aggression in childhood, i.e., gang leaders, bullying, and temper tantrums; juvenile court record; and truancy and disciplinary problems in school. His findings suggested that resentment against parental, school, and community authority was a common denominator in the accident repeaters investigated.[4] In school districts which have a guidance program, the counselor would be a valuable resource person for the driver education teacher in identifying and helping students who will have driving difficulties because of negative attitudes toward society.

Explaining to the Student His Limitations, as Shown by Physical Fitness, Reaction Time, Visual, and Other Psychophysical Tests, and Helping Him to Compensate for His Limitations

Individuals differ in physical abilities to drive. A part of most driver education courses is testing of vision, hearing, and reaction time. The results of these tests are not part of the student's grade for the course. They are used by the teacher to interpret to a student any limitations in physical ability for which he must learn to compensate. These tests also serve to show beginners that the drivers they will meet on the road will vary in physical ability.

Vision tests are particularly important in those states where a learner permit is issued to students without any test of visual ability. A newsletter of the California Driver Education Association emphasizes teacher responsibility in this area:

> Teachers in general are becoming increasingly aware of the value of a visual survey before taking a student out in traffic. Most states and school districts hold the instructor morally and legally responsible for the safety

[4] William Anthony Tillman, M.D. *The Psychiatric and Social Approach to the Detection of Accident Prone Drivers.* Master of Science Thesis. London: University of Western Ontario, 1948, 99 p., p. 58.

of each student while he is behind the wheel of a dual-controlled car. The growing number of students being discovered with limited vision has caused teachers to screen these students with increasing thoroughness.[5]

The descriptions submitted by teachers on this topic illustrate the arrangements for conducting the tests as well as the uses and limitations of psychophysical testing.

How psychophysical tests are used by one teacher — Early in the semester each driver education student should have some idea of his physical limitations and know to what extent he can learn to compensate for them. Before the tests are given, the class studies the effect of physical abilities on driving, the range of normal abilities, and the compensations which can be made for particular disabilities. In one school, the school nurse is given a list of the driver education students to check for visual acuity. Approximately 16 percent of the class is found to need visual correction to meet the state requirement of 20/40 vision. (Other teachers also reported that they have found many students who could not qualify for practice driving without corrective glasses.) Other tests of vision are given in the classroom. These include tests of field of vision or tunnel vision, color blindness, and glare recovery. Students with limited fields of vision are cautioned to drive slowly and are given instruction in the technic of moving the head from side to side to increase the field of vision.

A reaction testing device is also used in the classroom. Each student figures his own average after 10 trials on the machine. He then compares his average with the average stated in the text for simple reaction time, and the average given for normal driving conditions. Each student makes a graph of his estimated stopping distance at different rates of speed. This teacher believes that these graphs help a student to become familiar with his own limitations. By comparing his graph with others, each student becomes aware that he must drive defensively to protect himself from the limitations of other drivers.

Tests are given on the practice driving area — One teacher uses the practice driving area as the site for reaction time tests. The reality of the situation helps to impress students with the necessity of adding the time required for deciding to stop to their personal reaction times and to the braking time.

"Orderly confusion" during the testing program — In one teacher's classroom, each of 30 to 40 students must leave his seat on six different occasions to go to each of the testing devices. Without preliminary planning, the situation can become too disorderly for the tests to be given. Consequently, this teacher has made arrangements to reduce the confusion:

> First the purposes of the six tests and the testing procedures are explained. Then each student makes out a card to record his scores. The card is designed so that it may be kept as a record inside the textbook cover. They are told that while these test scores are not part of their grade for the course, their character trait grades will be influenced by their behavior during these tests.
>
> The testing devices are operated by student assistants who have been specially prepared for this task. Those students not occupied at a machine are put to work writing the answers to open book study questions which have been written on the blackboard. It takes approximately five class periods for the testing, discussion of the results with the class, and the discussion of results with individuals.

A simple exercise to illustrate reaction time — Another teacher has found that the standard reaction time tests embarrass some students and build false confidence in others.

> He has 10 students stand in a circle within an arm's length of each other and with the left shoulder toward the center of the circle. Each looks upward and to the right so that he can see no other person in the group. To illustrate the time required for simple reaction, the leader taps the shoulder of the person ahead, who then taps the shoulder of the next, etc., on around the circle. The leader times the interval until he is tapped. The total time elapsed is the reaction time for 10 people.

[5] California Driver Education Association. *Caldea Calendar*. (Newsletter of the Association). Palo Alto: The Association, Vol. III, No. 4, March-April, 1956, 34 p., p. 12 (Mimeographed) (Bob Fraser, Editor, 44 Lincoln Ave., Los Altos, Calif.)

> One-tenth of this figure is the average response time for a simple reaction where the action is anticipated. This exercise serves to convince students that reacting to a stimulus does take time.
>
> The next demonstration with the same group includes an element of decision to illustrate that more time is required whenever a decision must be made. The procedure is the same except that the leader will touch some part of the body of the person ahead who will then touch this spot on the person ahead on the opposite side from which he was touched, etc. The rest of the class watches for faulty responses.

This demonstration illustrates that whenever a decision is required before a reaction, the time required is increased (perception time), and that whenever decisions are required under pressure, some people will make mistakes. The discussion which follows these demonstrations points out that all of the people involved were alerted. The conclusion is obvious to the students that in normal traffic situations, at least some of the drivers involved would not be alert and a still longer reaction time would be required.

Timing the psychophysical tests — Beginning students in some states are required to take tests of vision and a basic test on the rules of the road before a learner permit is issued. A teacher, working under such a state law, described a plan for scheduling the psychophysical tests. At the beginning of the course, the tests required for a state learner permit are explained to his students and they are told that more extensive testing will be done at a later date. These preliminary tests arouse student interest and at the same time tell the teacher a little about the abilities of the prospective student. In the third or fourth week of the class, the psychophysical tests are explained fully and then are administered in the classroom. Then this teacher schedules individual conferences to discuss the results and the corrections and compensations which are indicated. During the last week of the course, each student takes the reaction detonator test. The results of this test along with the results of the four basic driving tests are entered on two cards. One card is kept by the teacher and the other by the student. At this time the teacher again explains the implications of the reaction test score.

Explaining the limitations of the reaction and visual tests — In one respondent's classes in a teachers' college, emphasis is placed on the limitations of the reaction time and visual tests:

> Classroom reaction tests are performed under conditions far more ideal than those in actual driving. An intelligent and quick appraisal of the over-all driving situation must precede the decision to apply the brakes. He emphasizes that the time required for decision is more dependent upon habits of appraising the driving situation and upon experience than upon reaction time. In addition, the ever-changing factors (weather, surface of the road, amount of traffic, conditions of brakes and tires, and condition of the driver) limit the degree to which one should rely on his reaction time test scores. To demonstrate this point, the class is taken to an intersection of a main highway and secondary road. At this spot the teacher points out the multiplicity of situations which may arise. Then a student driver enters the thru traffic from a crossroad where visibility is limited. The group observes the time it takes the car to accelerate from zero to 30 miles per hour as compared with the time it would take an approaching car and possibly an over-taking car (beyond vision when the turn is started) to cover the same distance. They note that fast reaction time alone does not solve the problem.

The class also discusses how the general state of health, fatigue, and bulkiness of the driver's clothing, and the weight of shoes slow down a driver's reaction.

The validity of tests of vision are questioned with the class since, in actual driving, the field of vision is seldom normal. Corner posts, passengers in the front seat, rain, and snow are a few of the factors which limit a driver's vision.

As a result of this type of instruction, the students seem to have a broader outlook on driving. They also realize how complex are the decisions a beginner must make. Also, the more experienced drivers in the class become aware that what they do automatically is the result of experience and is composed of many judgments and skills.

Explaining how age affects physical abilities —

One instructor explains to his class that with advancing age an individual will not score as well on the psychophysical tests. So he takes the tests with his students. Altho he drives better than they, many students make better scores on the tests. He uses the comparison between his and their scores to show that experience in driving compensates for the loss of physical advantages of older drivers.

Summary — Experienced teachers recognize that psychophysical tests are useful with beginning drivers. They aid the teacher and the individual in identifying potential difficulties due to sub-normal vision and hearing, or poor neuromuscular coordination. (Vision tests are particularly important before road practice begins in those states where a learner permit is issued without these tests.) The tests also serve to develop student awareness that all drivers sharing the road do not have equal abilities.

Recent investigations of groups of accident-free and accident-repeater drivers have found that no great differences exist between the two groups in respect to physical abilities. For the driver education teacher, this indicates that these tests, altho useful, should be accompanied by a full explanation of their limitations in order to prevent students from associating good scores on the tests with superior ability to drive safely.

Testing and Grading a Learner's Performance

Just as in other subjects, driver education students are tested and graded. Altho standardized tests are available commercially for most texts, many teachers still rely on tests of their own construction. In addition to tests of knowledge, tests of attitude development are also used. Also, instruction in the practice driving car is accompanied by evaluations of a student's ability to drive well and safely on the road and to perform certain skill tests. One teacher said:

> It is very difficult for a conscientious teacher to appraise student development. A series of pencil-and-paper tests will not do it. I take the entire student into consideration when giving a final grade. I make an attempt to find out what the course has done to the student as a total individual. This is quite difficult to do as any teacher knows. When a person learns, he learns all over.

A composite record form — A respondent sent a record form designed so that all information about a student (personal and course progress) can be entered on one form. Its purposes are:

1. To aid the driver educator to become more effective in his teaching
2. To enable the driver educator to learn more of the "whole" student with whom he worked
3. To enable the student to benefit from a more accurate reporting of his progress
4. To permit a more objective evaluation of the driver education program and thereby provide bases for improvement
5. To provide certain bases for long-range evaluation, primarily for research purposes.[6]

The major sections of the record form include (a) the student history (medical, behavioral, and academic), (b) results of the psychophysical tests, (c) classification of the program, (d) progress record, and (e) final report including space for information on whether the student was granted a license.

Classroom tests — Classroom testing requires a lot more planning on the part of the teacher than practice driving tests according to one respondent who teaches both phases of the course:

> This teacher makes out work sheets covering important parts of each chapter. In the classroom, discussion is focused on the questions developed in the work sheets. Short completion and true-false questions follow each assignment and each film. These also are developed with reference to the work sheets. The end-of-course test is the standard one designed for use with the textbook. After each test, this teacher divides the class into several small groups each headed by a good

[6] Earl D. Heath. *Instructions for the Use of the Student Record in Driver Education.* New York: Center for Safety, New York University. 4 p. (Manual accompanying the form, *Student Record in Driver Education.*) (No date)

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student. The students in each group go over their test papers and discuss the answers. The test thus serves as a guide to further learning.

A driver educator from a state teachers college wrote that he uses a three-source testing program for classroom work: (1) standard tests accompanying the text are used; (2) teacher-made tests are given which include questions of multiple choice, true-false, matching, short answer, written discussion, written solutions to problematic situations, and student-made tests; (3) each student is given the opportunity to evaluate his own work. At intervals during the course a student is required to give himself a grade and then defend the grade he has assigned. For class participation activities, students rate one another using prepared rating scales.

Pre- and post-course tests of attitudes — Two teachers reported that a standard attitude test is given twice to each class. One of them wrote that the test is given the first day the new class meets without any advance notice or student preparation. The scores on this test are retained. Then the test is repeated at the end of the course and the scores are compared. Thru comparing the scores, he has some objective basis for evaluating a student's changes in attitude toward driving.

Some authorities in traffic safety education and educational psychology have cautioned about the limitations of tests which purport to measure attitudes. A student may indicate that he would handle a social problem in the way he thinks the teacher approves while in a real situation he might behave quite differently. Travers says:

> It is the opinion of the writer that inventories as yet available for measuring the personality characteristics of normal individuals are of use only for experimental purposes. They do not provide a satisfactory basis for discovering the characteristics of pupils in the higher grades. The direct observation of the pupil must remain the teacher's primary source of information about pupil development, and the rating scales will remain useful devices for focusing attention on what is to be observed and for providing uniform methods of recording.[7]

[7] Robert M. W. Travers. *Educational Measurement*. New York: MacMillan, 1955. 420 p., p. 225.

Individual record sheets for practice driving instruction—Several teachers recommended that individual student record sheets in practice driving be marked during or at the conclusion of each lesson.

One teacher wrote that students like these sheets for several reasons. They provide definite grades for specific activities and an idea of how they are progressing in the course. In addition, the teacher is reminded of a student's mistakes and weaknesses in previous lessons so that he can repeat his instruction with the student and not just let the mistakes slide. The record sheets also help the teacher in arriving at final grades. Standard forms are available commercially. Several teachers also sent copies of driving records they had developed and mimeographed. One form is headed by blanks for the name of the student, his address, phone number, course hour, and group number. The items to be checked, skills or maneuvers, are listed on the left side of the sheet. Opposite the list of skills are enough blank columns to cover each time the student drives.

Administering tests in practice driving — According to one respondent, by the end of the course each of his students will have had six road tests, at least three of which cover all phases of the driving course. For these tests, each student is taken alone in the car with the teacher so that he neither depends on nor is disturbed by the other students. Each test lasts about ten minutes. This teacher also uses an individual record sheet to check a student's performance on road tests. This sheet is returned to the student after each test so that he can practice or study the items where performance was poor.

Adapting the road test to student ability — One teacher has found that driving conditions on the final road test must be varied to suit the abilities of a student and yet be within the limits of what will be required initially of a licensed driver. Those advanced enough, drive in the heaviest traffic the teacher can find. Groups of four spend all afternoon on this test as the teacher checks the performance of each one on a standard form. Each student in the car may call out a mistake which will be recorded

if he is not overruled by the instructor in the interest of fairness.

This teacher wrote that the atmosphere of the test group is similar to that in a game where each person tried to "get something on the other fellow." His job is to establish among these students a serious purpose without getting grim about it and usually a simple explanation takes care of this. The students are told that the primary purpose of this test is to increase their driving experience and that the score sheet will be their own property when the test is over. This way avoids a deadly serious atmosphere where a driver's nerves might reach the breaking point. Two values seem to result from this experience: (a) pupils realize that there is more to good driving than they have suspected; and (b) they realize that driving is something on which they must keep working.

An unfamiliar route for the road test — To see how well a student reacts in a strange driving situation, one teacher conducts a part of the final road test over an unfamiliar route. If a student has mastered the fundamentals, he generally drives fairly well over a strange course. After the student passes this test successfully, he is then sent to the state police to take the test for his license.

A familiar route for the road test — Another respondent selects a route which includes the most typical driving situations that can be covered in the time available. The first driving tests on right- and left-turns are conducted on city streets where there is relatively little traffic, but the final test is conducted in the heaviest traffic in the town. In each case, his students have practiced over the same course several times before the test so that they know what turns to make and can devote their attention to the traffic situations. A check sheet is used to score the test. A student's mistakes are pinpointed so that it is much easier to show him exactly what he did wrong.

Same test given twice — Another respondent also conducts the road test over a prescribed course selected to provide a variety of situations. The student driver is checked for errors in operating the vehicle and for traffic violations from the time he enters the car until he leaves it at the end of the trip. The same test is given in two different grading periods with the exception that there will be considerable improvement in the second test.

Planning, administering, and grading the road test — Altho informal evaluations of the student's driving and resultant suggestions to the student are a continuous process during the course, one respondent does not feel that a formal road test is in order until near the end of the course. He has observed that many good drivers have done very poorly as beginners.

> About a week before the road test is scheduled, this teacher passes out copies of the score form to his students so they have a chance to study it and ask questions. The statements on the form are all positive. They are things the driver should do. The test includes all operations and maneuvers covered in the course.
>
> Every person in the car has a sheet and rates the driver by checking opposite each item that the driver omits or performs incorrectly. When the driver has finished, the instructor and observers fill in the last section of the rating sheet entitled, "The Driver." He is rated on attention, attitude, operation of the car, control of the car, judgment, ability to anticipate driving hazards and take proper action ahead of time, and courtesy toward other drivers. After the rating sheets have been turned over to the driver for review the teacher discusses them with him and offers suggestions for improving his driving.
>
> On the basis of this rating sheet, grades are assigned on a five-point scale, A to E (from superior to unsatisfactory). Altho this method of marking is subjective, the teacher feels that it has an objective base. A pupil has had his attention called to the positive aspects of good driving. He has these desirable practices further impressed upon him by looking for them in his classmates' driving. Furthermore, he has had a written critique of his driving from three of his classmates and the instructor.

The students plan the test route — In one school each student plans the route he will drive in taking the final test. He is instructed to travel by the most practical route in a triangle from the high school to

a well-known place on the east side of town, then to a place on the west side of town, then back to school.

This teacher has observed that some students are uncomfortable or distracted if the teacher writes on the test form while a student is driving, so he makes mental notes of driving errors and withholds comment until the student is finished. The instructor has found these technics excellent for checking driver attitudes as well as the student's ability to plan his driving.

Post-course testing — Four to six weeks after one instructor's students have obtained their state licenses, he calls them back and has them drive the practice driving car. He has observed that while they show a remarkable improvement in confidence, driving habits have become a little lax. He takes this opportunity to call their attention to faults which are developing before they become deeply entrenched bad driving habits.

Grading classroom and practice driving work — A student is expected to complete both the classroom and car phases of the course with satisfaction. According to one respondent, success in one phase does not off-set failure in the other. Written work in driver education is evaluated by the same standards as in any other course. Because of the tendency of some students to emphasize the driving phase of the course and neglect the classroom work, it is sometimes necessary to withhold driving privileges until the classroom work is completed. Altho in this case no credit is given for the course, the grades are shown on the student's report card and permanent record.

Summary — Tests in driver education are especially realistic in that they are built around actual situations which are within the students' personal and current experiences. The teachers who wrote on this topic indicated that they are using tests in the classroom and in the car as learning as well as evaluating experiences for the student. A tendency is noted to adjust the test to the ability of the individual student, yet meet what will be required of a beginning driver.

In conducting tests in practice driving, teachers differ on what are the best arrangements. Some teachers prefer to check off the drivers' errors as they occur so that the critique is specific. One teacher checks acts correctly performed rather than the errors. Another teacher makes only mental notes of the errors to avoid making a driver nervous. Some teachers prefer to conduct the final road test over a route familiar to students. Others prefer to have them drive over an unfamiliar route in order to observe how well they adjust to strange traffic conditions. Still other teachers allow a student to plan the route he will follow to reach a specified place. Several teachers conduct the tests with observers in the car who help him check the errors of the driver. Another conducts tests without observers. Some teachers make formal evaluations of the student's progress at the completion of each stage in the learning process. Another teacher makes only informal evaluations during the course and since many good drivers were very poor beginners, delays the formal road test until the end of the course.

IV. SELECTING MATERIALS, EQUIPMENT, AND ARRANGEMENTS FOR DRIVER EDUCATION CLASSES AND DRIVING GROUPS

Successful driver education teachers are aware that something more is needed than a Mark Hopkins kind of interchange on a log. Wise selection of teaching aids, equipment, resource persons, etc. provide the settings for more realistic learning experiences than the teacher can hope to create verbally. Their use can not and should not supplant the teacher-pupil relationship.

Materials have a vital place in the curriculum, but they also place a responsibility on the teacher. Both opportunities and pitfalls are present. The uses of equipment, aids, resource persons, demonstrations, and the like are technics.

Successful technics should emerge from and be appropriate to the understandings a teacher is trying to develop. For example, from building models of intersections, a student may learn only how to build a good model. The teacher must take steps to see that part of the learning is an understanding of the hazards intersections present to the driver. The resource person may be more interested in promoting a service or product than he is in imparting information about how his work relates to traffic safety. The aid or resource should not run away with the experience, work at cross-purposes to the teacher's, or have a goal which is not in harmony with the goals of the course.

Turning to the Community

From the community, the teacher can find good speakers on special topics for driver education students. The class can also go out into the community to observe an agency at work or to observe driver and pedestrian habits. The resources frequently used include: (1) state and local police; (2) traffic courts; (3) motor vehicle departments; (4) garages, automobile dealers, and factories; (5) fire departments; (6) insurance brokers; (7) oculists and optometrists; (8) ambulance companies; (9) motor clubs; (10) newspapers; and (11) safety organizations. State and local police officers and police stations appear to be most frequently used.

Making best use of the resource — Several teachers wrote of the arrangements they have used to make projects based on community resources particularly successful learning experiences. In one instance, the automobile mechanic in a local garage is a former army classroom instructor. He does an outstanding job of explaining the mechanical operation of the car in the hour allotted. In another case, the respondent has alternated two local optometrists as speakers. This avoids criticism of partiality. The students of another respondent have a weekly column in the town newspaper for which they write articles on traffic safety. Both the teacher and his students attend parent-teacher open-house meetings and give psychophysical tests to adults using student-made equipment.

In writing on other topics, teachers suggested these arrangements: former driver education students who are now police officers may make very good class speakers; and in planning for a speaker or a field trip, the experience has more meaning when the individuals involved have been contacted and briefed on what the class needs to learn about their work. Also the class should know what to expect from the speaker or the field trip.

Student projects based on the use of community resources — At the beginning of the semester, one instructor issues to each student a list of about 30 projects which involve the use of one or more community resources. The list includes suggested methods for the projects and other pertinent information. After reviewing the list, each student is required to select a number of projects to complete as the semester progresses. The due-date for each project is set to coincide with the topic the class will be discussing. Each project is submitted as a written report and then is summarized for the class.

Typical projects include:

1. Spending an hour in observation of the local traffic court.
2. Conducting a pedestrian violation, moving traffic violation, or parking violation survey in the school neighborhood.
3. Visiting three different garages to secure prices on various types of repairs to a specified make and model of car.

Another respondent has the students work on similar projects in groups of from four to six students. Assignments to visit local traffic courts, police stations, and intersections are rotated so that each group has an opportunity to visit and report on all situations. During these projects, the students make use of wall charts, displays, current statistics, and photographs taken with their own cameras.

Taking advantage of an unusual event — The alert teacher can take advantage of unusual events in the community to provide sound learning experiences for his class. One teacher reported a good example of this:

> While at a garage he noticed that the mechanics were preparing to change bodies on a car which had been wrecked. He got permission to bring the class in for a visit at the time when the body would be completely removed from the chassis. This afforded an opportunity for the students to see the actual working parts of the car.

Summary — Just as the act of driving is a way of participating in part of the life of the community, so do driver education teachers seem to see that the community is a part of the learning environment. They draw heavily upon its resources in ways which enhance their teaching.

Respondents saw a threefold aspect to community resources: (1) drawing in persons who have specialized knowledge and skills to contribute to the classroom work; (2) using the community as a laboratory in which students gather data needed for solving problems in traffic safety education; and (3) capitalizing on features unique to the community and/or on chance but fortuitous events.

A continuous alertness to the ever-changing nature of a community and its problems, and devising ways to utilize them to forward teaching goals, seem to be measures of a successful teacher.

Selecting and Evaluating Classroom Teaching Aids

This section deals with films, mock-ups, trainers, flannel boards, and other similar equipment which are available commercially or may be made by the teacher or the student. Each aid should be evaluated in terms of a student's speed of learning, comprehension, and retention, and in terms of the cost in money and in time it takes the teacher or students to prepare it and use it.

There is no dearth of teaching aids available in this field. A teacher who is over-receptive to aids may find that he has collected more than he can use, catalogue, or store. This teacher's primary task is to obtain or construct the aids which are best suited for his teaching situation. Aids range in complexity from simple teacher-prepared charts to elaborate devices to simulate driving.

Selecting aids to fit into the course outline — One

respondent recommended that the selection of aids should be preceded by the preparation of a course outline showing the number of lessons or periods available:

> In making this outline this teacher has in mind a sequence of learning experiences. Each lesson includes a summary of previous lessons, the presentation of the new lesson, and the introduction to the next lesson. The aids are selected and prepared well in advance—during the summer vacation if possible. The course outline is the guide, particularly in selecting and ordering films which will be used by the class. The planned use of pamphlets, film materials, flannel board, blackboard, charts, etc. is noted on the course outline.

This respondent has found that aids are most effective when he has prepared his class by informing them what to watch for and what knowledge or understanding the aid will help develop. After the aid has been used, the pupils discuss what they observed and how it relates to the objectives of the lesson. Then the aid is evaluated in two ways: (1) the teacher notes and records student reaction to the aid; and (2) a test is given to determine the outcomes of learning. It is helpful for this teacher to retain this evaluation of a specific aid to guide him in deciding whether to use it again or to look for a better one. He concluded that a well-prepared outline of the entire course is worthwhile for these reasons: a teacher is able to see, and therefore better able to teach, the relationships between the objectives of the individual lessons. When the aids and the evaluations of them are added to the outline, he is able to improve his instruction year by year.

Another respondent wrote that since the driver education films arrive on a different schedule every ten weeks, a great amount of time was required to revise true-false questions. A file of cards was prepared with a few good questions from each film. Now each ten weeks, the teacher notes the titles of the films the current class has seen. At any date appropriate questions can be pulled from the file and revised for a quick test.

Construction of a magnetic board — One teacher submitted detailed directions for the construction of an inexpensive magnetic, relief-type model of roads and the terrain. On a piece of 4′ x 8′ celotex composition board his students outline the road map. Hills are made by crumpling newspaper to get elevation. Then the newspaper is covered with paper towels pasted one on top of the other for strength. The roadways are cut from thin sheets of tin approximately the width of small toy cars. Both roadways and the countryside are painted appropriate colors. Small magnets are glued to the toy cars. Then inexpensive houses and figures are glued to the landscape.

The respondent who submitted these directions teaches in a state school for the deaf. In his teaching, visual materials in the classroom are a most apt means of communicating with these students. They are particularly useful in teaching the correct maneuvers and placement of cars for all types of driving situations. The teacher has noted marked improvement in the speed of learning and the degree of comprehension.

Another respondent also has the students illustrate typical traffic problems with relief models. They make these models as individual or group projects. A mixture of cream of tarter, sugar, flour, and water is inexpensive and easy to use because it dries hard without flaking. Some of these models are kept for use with later classes. Others are given to elementary teachers, thus encouraging other teachers to teach safety.

Teacher-made slides — A teacher, whose hobby is photography, reported making his own slides for classroom use. He mounted a 35mm camera in his car and takes pictures of critical situations as seen from the driver's seat. He makes other slides by positioning model cars on a board marked to show intersections. This teacher plans to work out a set of questions about correct driver reactions in the situations portrayed.

Using a map — A large street map of the city is used by one respondent to reinforce student development of a community approach to traffic safety education. Here are recorded all types of traffic accidents occuring in the school district. All members of the class work on this project. They note all information regarding accidents which they have seen, heard of, or read about, and the violations involved. Each accident is classified by the types of violations involved and is recorded by a colored pin. The respondent has found this project and the discussions which emerge from it help lead students from a lethargic attitude toward violations and accidents to an attitude which is conducive to community participation in correcting traffic problems.

Making maximum use of the classroom environment — The classroom itself can be an important aid in teaching driver education. One respondent builds a definite driver education atmosphere thru bulletin boards and exhibits. Student-made exhibits permit frequent changes of material.

The first test given in his course is an "open-room" quiz. Answers to questions can be found on material displayed around the room. Students like this idea, and after the quiz the exhibits receive a great deal more attention.

Planning a trip — Three respondents teach students how to use maps and community resources thru planning a trip as a class project. One of them saves this project until the end of the course when the texts have been collected. Interest in the project is usually high enough to carry the class over what otherwise may be an unfruitful period. The project takes from two to five days. He usually introduces it by saying, "Let's leave school tomorrow for a visit to the capital of the United States. Our time is limited, so let's pick the most direct route."

A large road map of the United States is obtained for each two students. A discussion of the best routes brings in problems of the season, weather, traffic in large cities, detours, etc. Then his students obtain pertinent information from automobile clubs and oil companies.

While his students are examining the map, their attention is called to the system of federal highway numbering. They are usually surprised to find that routes with even numbers run east and west with the small numbers in the north, and that routes with odd numbers run north and south with the small numbers in the east. They also discuss what should be checked before leaving home, and the equipment needed on the trip and for overnight stops. Then if there is sufficient time, they can plan a more leisurely return trip with visits to points of interest along the way.

Summary — Respondents reported extensive use of a wide variety of teaching materials — films, slides, maps, models, magnetic boards, etc. Of particular interest are the aids which the students develop as individual or class projects. Apparently the problem is not one of scarcity of ideas, but rather that of wise selection from a great range of projects and the best use of a few.

The teachers who wrote on this section stressed the value of extensive preparation for the use of aids. This involved fitting the materials into the continuous learning program and preparing the class before an aid was introduced. They also saw the need for continuing to evaluate the worth of aids. Emphasis was placed on the value of integrating all aids into the classrom environment.

Devising and Evaluating Ways to Supplement a Student's At-The-Wheel Experience

Teachers frequently find that the time the course allows is inadequate for developing experienced drivers. Methods suggested to supplement the students' at-the-wheel experience include: (1) use of the family car under parental supervision; (2) use of advanced students as assistants to the teacher; and (3) simultaneous supervision by the teacher of several practice driving cars on an off-street area.

An evening meeting with parents — One respondent believes parents should take an active part in the development of their children as safe drivers.

> Early each semester he requests that all parents of his students attend an evening meeting. At this meeting he presents the philosophy of the driver education program and outlines the technics he will use to teach a new driver. He also emphasizes the importance of parents setting good examples of observance of laws and rules of safe driving. At this time he also encourages parents to give students additional practice with the family car.

The results of these meetings have been encouraging as evidenced by the more rapid advancement students make thru additional practice and the promotion of good relations and cooperation between teacher and parents.

Reporting additional practice — After a student has driven with his teacher for from six to eight weeks, he is encouraged to get additional practice with a licensed driver in the car beside him. These students are given forms to turn in so that this practice may be recorded. The form includes space to write in the name of the student, date, name of the licensed driver, and location of the practice. The time turned in is recorded but does not count toward the practice driving hours required in the course.

End of the course report to parents — At the end of the course, one respondent sends a postcard to the parents of each student. On it he asks the parents to supervise the student's driving until he has had more experience. He also informs them of weaknesses in a student's ability and gives a frank appraisal of his driving behavior.

Use of student assistants — One teacher reported that he uses student tutors to provide additional practice for beginners who are slow in learning. No details were given on the training of the tutors or the site for this practice.

The report of the National Conference on Driver Education said about the use of student assistants:

> Student assistants of teacher-aids with adequate qualifications, special preparation, and careful supervision can help materially in extending instruction to more pupils on off-street driving areas. After the learner, under supervision of the regular teacher, develops an understanding of the steps to be practiced in a given lesson, the student assistant can sit beside the learner and safeguard his further practice of skills. This plan could result in saving teacher time and in reducing instructional cost. Combining the use of student assistants, or teacher-aids, with the so-called "multiple-car plan" of off-street practice driving instruction is worthy of trial. Such groups as high-school and college chapters of Future Teachers of America, and students in teacher education programs would be logical sources of student assistants or aides.[8]

Summary — The use of parents, licensed drivers, and student assistants should be approached cautiously and only following instructions given by a qualified teacher. This section described the arrangements three teachers use to provide additional practice. It is to be noted that two of these teachers advise practice with parents or other licensed drivers only after the student has completed or partially completed the course. Another instructor has his students practice with parents; however, the parents are informed in an evening meeting of the goals of the course and the methods of instruction the teacher wishes them to fellow. In all cases reported, the practices tend to be somewhat limited and controlled.

Selecting the Route Over Which Students Should Operate Cars or the Effective Use of Practice Areas

> Seldom do we find practice conditions exactly to our liking for specific lessons. It is very important that these practice conditions be just as near to actual driving situations as possible.
>
> —*A Driver Education Teacher*

[8] Op. cit.

How the route is selected — Advanced planning is required in selecting the best routes for practice driving. One respondent suggested that it is helpful to procure a map of the area in which most of the practice driving will be done. On such a map he can show the following: (1) the width of certain streets where "U" and "Y" turns may be negotiated; (2) areas where parallel or angle parking are permitted; (3) service roads where certain maneuvers can be practiced; (4) areas with a good sampling of various signs, signals, and markings; (5) one-way streets, various types of intersections, and the like; (6) such hazards as blind curves, sharp curves, railroad crossings, etc. When the route for each lesson is planned from the marked-up map, the time in the car is used more fully.

A practice area — All of those who wrote on this subject advised some use of an off-street area for beginning students, altho they differed on when a student should be advanced to street practice. One teacher wrote, "I believe in getting the student in traffic as soon as possible. Too many bad habits are formed by those students who are accustomed to driving in areas where they do not have to watch for traffic. Starting the beginner in traffic is the slower method, but why have him learn two or three sets of habits and end up with nothing." Representing the other point of view, another respondent wrote, "I have found that the beginning driver should first practice 'off the street' and advance to street driving when he shows good driving ability. The student should be allowed to advance at his own rate. In this way, the student is more at ease and the instructor can be more relaxed and live longer."

The experience of the teacher, the ability of the student, the traffic in the area around the school, and the time allotted for the course are all factors which should determine how soon a student is advanced from off-street practice to light traffic driving.

Where an off-street area is not available — In this case, a street where there are few if any moving or parked cars is selected. In some cases it is possible to secure permission from the local police to block off a street during the practice periods.

Setting up an off-street area — Many instructors use the school parking lot or a large vacant parking lot for off-street practice. Other schools have constructed driving ranges with curbs, streets, lines, parking and turn-around spaces, signs, and signals.

One respondent wrote that this was the first year his school has had a driving range. He found that it saved a great deal of time formerly spent putting down temporary markers and stanchions. In addition, the driving range has created good public relations since it is used by adults for driving practice after school hours and on weekends.

Directions for laying out a range were submitted by a respondent:

> The area is laid out as a right-angle course giving three different turning radii (six where the direction is reversed). The dimensions of the triangle are 200′ base, 365′ hypotenuse, and 300′ altitude. There is a double center line with two lanes on each side. Fifty feet before each turning point there is a mark on the double line—the point at which the student gives a signal. Parallel lines for backing practice are painted in the center of the triangle, areas for parallel and angle parking at the curb on the perimeter. The respondent has found that it takes from two to four periods on such a practice area to develop good habits for starting, stopping, backing, turning, and signalling.

The staff selects the driving route — The driver education staff of one school discussed what was needed and then selected the best areas for practice in the community. Altho the lesson plans were developed by the program supervisors, the choice of the ideal place to conduct each lesson rests with the individual instructor. Frequently, the teachers consult each other informally on problems of selecting routes for specific lessons.

Criteria for selecting the routes — One respondent listed the criteria for the area in which the lesson is conducted opposite the subject of each lesson. The lessons and the criteria are:

1. Under the hood, panel and gear-shift	A sheltered area, a garage if possible. A parking lot is the second choice.
2. First gear	One or two blocks of a lightly-travelled street with curbs.
3. Second gear	Same as above but expand to a four-block area.
4. Third gear	Select another four-block area with a little more traffic.
5. Left and right turns, hand signals	Keep traffic at a minimum but cover more territory. Make a turn at every intersection.
6. Downshifting	Select a street with ascending and descending grades and turns. Traffic should be slow-moving.
7. Backing	Conducted on an off-street area, a parking lot or private drive.
8. Angle parking	Parking lot. Place stanchions if necessary.
9. Parallel parking	Lightly travelled street with curb Use flags to simulate actual parking conditions.
10. Hill driving (starting and stopping, parking)	Moderate grade sufficient
11. Review of turns and signals	Medium traffic
12. Light traffic driving	Medium traffic. Some "T" or "Y" intersections. Stop signs, traffic signals.
13. Heavy traffic	Thru central business district
14. One-way streets	One-way streets. Main traffic arteries and alleys.
15. Country driving	Heavy and light traffic, preferably on roadways without curbs.

Use of unplanned route — As soon as a student is fairly capable in traffic driving, one respondent instructs him to drive to familiar places — his home, well-known stores, churches, etc. instead of using a pre-determined route. This technic works well in a small city where the students are familiar with the location of most places.

Another respondent wrote that near the end of the course, his students drive to another city where they must watch for new signs, lights, and markers. This lesson is usually conducted after dark to give them practice in night driving.

The route is determined by the ability of the student — After the lessons on fundamental operations, the students of one instructor are classified into three groups: "A" for above average ability, "B" for average ability, and "C' for below average ability. The "A" students practice on city streets; the "B" students practice on quiet residential streets; and the "C" students continue to practice on the parking lot until they develop average ability. The driving groups are not rearranged. "A", "B", "C" students may be in the car at the same time so that during one period three different routes will be used.

Summary — Most of the respondents seemed to feel that a student should have a good mastery of the fundamental operations of driving before being exposed to traffic situations. On the other hand, two teachers were firmly convinced that the fundamental operations should be taught in light traffic so that from the beginning a driver learns to watch for other cars and pedestrians. All of the instructors advanced their students gradually from off-street or very light traffic to intermediate and then to heavy traffic as they developed ability.

Making the "Observation Time" in the Practice Driving Car a Profitable Learning Experience

There are both theoretical and practical reasons for having student observers in the practice driving car. Watching another student helps one evaluate his own performance. In addition, the arrangement is a practical way of multiplying a teacher's usefulness. The more ways in which pupils spend time with a good teacher, the more efficient the instructional program will be. Concern exists, however, as to the optimum size of the observation group, the basis for selecting students for that group, and technics which will make the experience profitable for observers.

Size of the groups — The number of students reported in the practice driving car varies from two to four, including the student at the wheel. It is not easy to discern if the number is dictated by administrative exigences, fixed by law, or is the result of the considered opinion of a teacher as to the best possible learning situation. In the opinion of one teacher, limiting the observer to one student means more watching and listening on the part of that observer since he will have no opportunity to chat about things other than driving — a propensity which this respondent and many others find prevalent among high-school students. On the other hand — some teachers prefer four students in the car at a time for what they can learn from each other, discipline being no problem.

Methods for selecting members of observation groups — The question as to whether the group in the car should be selected on a catch-as-catch-can basis or predetermined by one or more criteria is one which seems to plague both authorities in the field and teachers. A particular concern is whether to segregate boys and girls. Some authorities feel that boys and girls have such basically different problems in learning to drive that they should not be in the car together. Some teachers feel that disciplinary problems are increased thru mingling the sexes. One respondent reported he does not care to drive with mixed groups since either one or the other feels superior. While another teacher has found that the members of mixed groups do their best in order to impress each other.

Social homogeny is the solution used by one respondent. Groups are selected thru the use of sociometric methods. And while this method may be somewhat arbitrary in some instances, he has found that a compatible group in the car increases the effectiveness of instruction.

Holding the interest of observers — Another teacher secures interest by assigning "teaching" responsibility to the members of the observer group. As a teacher he must watch the road and is not in a position to watch the driver as much as he would like to do. Therefore the person behind the driver is responsible for checking the driver's signals and noting whether he cuts corners. The one in the middle notes the time allotted to each student and the position of the hand in gear shifting. The student behind the instructor checks the position and use of hands on the steering wheel and the speedometer. There is a constant emphasis that reminders should be made in a courteous way. Also, stress is placed on the advantages of each student helping the others.

Building the concept that the practice car is an extension of the classroom is a goal of one respondent:

> This teacher explains that the car is a classroom and that the students in the back seat are a part of the class. He points out that teaching pupils individually does not afford the learning opportunity that comes from group study, group performance, and observation while another performs. Each pupil in the back seat is asked to imagine that he is behind the wheel and to plan what he would do. If there is a difference between his decision and the maneuver made by the driver, he is to analyze the two courses of action and decide which was the correct or better one. At this point the student is a silent observer, but later when the instructor discusses the performance of the driver, all observers take part.

The use of rating devices to make observation meaningful — Several respondents formalized the roles of observers thru planned procedures and the use of rating forms.

For example, one respondent begins the driving lesson with a rule that no books be brought to the car except the outline for that particular lesson. In the beginning lessons, each observer is required to talk thru with the student who is behind-the-wheel the checklist series of steps to be taken—seat and mirror adjustment, starting procedure, safety checks, etc. Then, as each pupil in turn moves up to drive, each observer is given a simple three- or four-point checklist with which to rate the driver. The points for rating are those which have been taught in the preceding sessions. When a driver has finished, the teacher quickly checks each rating and then passes it on to the driver to keep. Similar checklists are used periodically, but not constantly during the course since this instructor feels that a point of diminishing returns may be reached if the technic is used to excess.

Another respondent has duplicated the 100-point scale used by the motor vehicle department, and has student drivers use it to check each other. He believes it is an aid to him as well as the student since the back seat observers are in a better position to judge some procedures than he is.

Summary — The responses to this section center about ways of coping with problems which arise from having observers in the car, and of making the observation time a good learning experience. One respondent summed it up by three questions: (1) How to get interest?; (2) How to keep interest?; and (3) Why some are not interested?

Acting upon the assumption that interest is synonymous with healthy learning, the respondents detailed suggestions as to how to choose groups, how to motivate groups, and how to set up formal procedures to attain these ends. They seem to vary in assessing the complexity and severity of the problem. To one respondent it could be met by elaborate arrangements; to another it was as simple as "Happy, but *strict* discipline."

Making Use of the "Demonstration Technic" Both in the Classroom and in the Practice Car

Demonstration is an established teaching procedure. In driver education, the term has acquired two distinct meanings. In the classroom, demonstrations are staged dramatically with the use of a variety of teaching materials. In the practice driving car, another form of demonstration is used, i.e., the instructor shows how a maneuver is done by actually performing it. Students observe the instructor and then attempt to duplicate his performance.

Making the classroom demonstration effective — The demonstration in the classroom is best when the presentation is new, different, and dramatic. These factors in a presentation catch and hold the students' attention, according to one respondent. An inexperienced demonstrator frequently overlooks student comfort. Seats should be provided when the demonstration will last longer than 15 minutes. There should be ample heat and ventilation in the room. If students must take notes, they need to be able to write comfortably. Duplicated material will supplement verbal explanation. And students enjoy participating in demonstrations or watching classmates participate.

In the practice driving car, this respondent uses the demonstration as part of an organized plan for presenting material.

His plan is: (1) review the previous lesson; (2) tell the current lesson; (3) give a verbal explanation of step-by-step procedure for the lesson; (4) give a thoro demonstration with appropriate verbal explanation; (5) ask for questions; (6) have a student get behind the wheel; (7) have him give a verbal explanation; (8) have the student demonstrate, with verbal help from the instructor if necessary; (9) have him practice.

This plan closely follows the traditional pattern used in skill teaching. The verbal aspect has been "dubbed" recently by some people as "commentary driving."

Is all this car demonstration necessary? — One respondent thinks not. He believes that too many teachers have an exaggerated opinion of the value of instructors' demonstrations in the car and waste precious student-behind-the-wheel time with it. To him a teacher is wasting time if he demonstrates to

each group of three or four students things that can be demonstrated in the classroom or to the whole class in the field. With his classes, he is behind the wheel for possibly four minutes the first time out for a brief "See — here's what we've been practicing in 'dry run in class,'" and four minutes the second time out for the drive to the practice area. He is not again behind the wheel for the rest of the semester. However, each of the early car lessons is thoroly previewed, demonstrated, and practiced in the classroom before car practice begins. Even parking, later in the semester, is first previewed by the use of a model car and blackboard and then it is demonstrated to the whole class at one time in the school parking lot during a class period. With 14 four-man groups each semester, every minute spent in demonstrating something to a group that, with a little ingenuity and planning, could have been demonstrated to the whole class is wasted. Also what many driving teachers feel must be demonstrated for each group separately can actually be demonstrated by an able student in the group when he is aided by a skilful, detailed talk-thru on the part of the teacher. While the teacher admits that this may sound like heresy, he says it works well for him.

Demonstrating advanced skills — A teacher described the demonstrations he gives for the driving groups and those he gives while the whole class watches the car.

For each driving group, these demonstrations are conducted with students in the car: (1) Assuming the foot-brakes have failed, stops the car by combining use of the hand-brake and engine deceleration obtained by double-clutching down thru the gears and turning off the ignition; (2) Shows how to start a stalled vehicle by bumper pushing, emphasizing how to keep the bumpers together and the appropriate time for the driver of the stalled car to engage his clutch in second or high gear; (3) Shows how an emergency spurt may be obtained by a rapid shift from high to second gear, and how to maintain momentum during the process.

Then before large groups, he: (1) Demonstrates the braking power of the gear system by having a group of students push the car when it is parked and left in the various gears; (2) Disconnects the main ignition wire and moves the car with the starter — an emergency measure; (3) Shows how a car may be bounced sideways; (4) Frees a jammed starter by rocking the car in high gear; (5) Assuming the battery is weak or dead, starts the car by coasting either forward or backward.

Summary — In driver education, the classroom demonstration is a high point in teaching. The best student learning occurs when the presentation of material is new, different, and dramatic. Teachers find that students enjoy learning thru well-planned demonstrations and participating in demonstrations.

Practice driving demonstrations are a vital part in planned skill-teaching. However, extensive teacher demonstrations in the car are questioned by one respondent as time-consuming. He suggests that they can be eliminated by demonstration and drill in the classroom, by demonstrations in the car with the whole class watching, and by demonstrations for the driving group by a good student aided by the instructor.

Teaching the Basic Mechanical Operations of the Car, Including Evaluations of the Teaching Aids Used

Teaching students to become mechanics is not a driver education objective. However, some fundamental understanding of the parts of the car and how they work together to produce movement seems to help some students gain competence in driving. It also can help in choosing a car and operating it efficiently.

Teaching the basic mechanics to a non-mechanically minded group — One teacher starts by having students who are familiar with engines take apart and explain the function of each part of an old washing machine motor. Those not familiar with engines, have to put it back together and explain the function of each part. Then the class takes a field

trip to a garage where a mechanic explains the parts of a car and how they function. This is before they study the text material on mechanics. After reading and discussing the text they go back to the garage. This time their questions to the mechanic show more advanced understanding of the principles of the internal combustion engine.

Studying different makes and models of cars — As a starting point in this unit, another respondent borrows the cars of several faculty members.

> These cars, different makes and models, are parked in a row. Those students most sophisticated in the field of auto mechanics serve as assistant "instructors" and "examiners." The first two cars in the line are the "instructor cars" where student instructors point out the parts of the automobile. After a student thinks he has had enough instruction, he goes down the row of cars and identifies for the examiners the parts of all of the other automobiles. At the last car a student examiner answers questions about how the various parts function.

A film and an assignment — After viewing a film on the internal combustion engine, one class is asked to describe with pictures or in composition form the life history of a drop of gasoline from the time it is put into the tank at the gasoline station until it is exhausted thru the tailpipe. Most students find this a particularly interesting assignment. Many pattern their stories after radio and television shows. A typical title is "The Autobiography of Gussie, the Gasoline Drop." This assignment is particularly useful with girls who are often not mechanically minded.

Summary — There is much controversy in the field about how much time should be spent on teaching the mechanical operation of the car, and how much fundamental knowledge of mechanics is necessary to give sufficient understanding of the car to drive efficiently and economically. The solution seems to involve several factors: (1) time allotted for the course; (2) familiarity of the students with mechanics; and (3) needs and vocational interests of the students.

Field trips to garages, disasssembling and assembling of simple motors, examination of different makes and models of cars, viewing films, and writing compositions are technics teachers are using to develop student understanding of automobile mechanics.

V. TEACHING THE OPERATIONS OF DRIVING AND DEVELOPING THE JUDGMENTS REQUIRED

This section deals primarily with teaching designed to develop drivers whose response patterns are consistently correct — efficient as well as safe. Learning to drive correctly involves an integration of accurate perceptions, the ability to make good judgments, and appropriate and prompt neuromuscular responses in constantly changing traffic situations. Thus to help a student, a teacher must have a thoro understanding of how such psychological processes operate, of how integration takes place. Perception is a key factor. Each student will perceive a new situation in terms of his past experiences with similar situations and the personalized meanings he has derived from these experiences.

Each stage of learning in practice driving is built on all previous lessons. Modes of correct and safe driving are initiated when a student is convinced that the method advised and demonstrated is reasonable and best.

> Practice driving instruction is much more exacting than classroom teaching. If a teacher has never taught driving skills to individuals or small groups, it will be difficult for him to imagine the extent to which his patience and teaching ability will be tried.[9]

Developing Good Habits of Routine Things to Do and Check

Safe driving starts with the driver's approach to the car. Therefore, some time is spent at the beginning of the course on developing correct habits of routine things to do and check before entering the car, before starting the engine, before pulling away from the curb, and before leaving the parked car. This stage of learning to drive is important *per se*. Also it introduces beginners to technics which are used thruout the course. They are: (1) learn the correct step and the reasons for it; (2) observe the demonstration; (3) perform the operation, noting the resultant action; and (4) practice repeating the performance — each time correctly — until the response becomes automatic.

Developing understanding of the procedure — One respondent's students develop thru discussion the steps to be followed in getting ready to drive. Each step is listed on the blackboard when a correct statement has been reached and satisfactory reasons have been established.

The six steps recommended by this teacher are: (1) check around the outside and beneath the car; (2) enter car from curb side with ignition key in hand; (3) place key in switch, but do not turn on; (4) adjust front seat; (5) adjust mirror or mirrors; and (6) check to make sure all doors are fastened securely.

An example of the rationale development for the first step is: (1) check for evidences of oil, gas, and water leaks; (2) check for nails, broken glass, or metal which could damage the tires; (3) check for flat or low tires; (4) check for closeness to other vehicles to aid in leaving the parking space; (5) check direction in which the front wheels are turned; (6) check for damage to car since it has been parked; and (7) check for children, animals, or objects in front of or behind the car. Other steps are developed similarly.

Memorizing a checklist — The students of another

[9] Leon Brody and Herbert J. Stack, editors, *Highway Safety and Driver Education*. New York: Prentice-Hall, 1954. p. 464.

respondent memorize, in order, these concise statements from a mimeographed checklist:

(1) *Starting the car*
Adjust seat
Adjust mirror
Depress clutch
Check for neutral
Ignition (turn key on)
Starter (press starter)

(2) *Start off*
Place in gear
Release handbrake
Check in mirror
Check blind spot (look out)
Signal for pullaway
Find friction point
Feed gas
Release clutch to power point

(3) *Stopping the car*
Check in mirror
Give signal
Declutch
Let up on gas
Put brake on

(4) *Parking the car*
Put on handbrake
Put into gear
Turn off ignition
Release clutch
Release footbrake

The teacher has found that when students memorize these steps before practice begins, actual performance is improved.

Procedures teachers use to help students retain the checklists — Several teachers wrote that they permitted no variations from the prescribed order of things which a driver must do before starting, stopping, and parking. Correct repetition was emphasized. They also found that teaching went easier when they had taken time to discuss the reasons for the order of items in the checklist.

One reported that he had the observers in the car call out the steps in starting and stopping the car. In this way, the steps are fixed after a few lessons.

Another teacher has found that students learn easier when items are presented in groups rather than as a long list of individual items. A key word to help in remembering the items is given where possible.

To convince students that a checklist must be committed to memory, one teacher shows and discusses with them the checklists used by pilots in take-off and landing operations. A parallel is drawn between the checklists pilots use and those which students are required to memorize and use.

Students are given many instructions to remember during the first few days of practice driving. These include rules about opening the windows, doors, tires, starting, etc. So one teacher has typed all of these rules on cards which are then placed on the dashboard with small magnets. Students are free to take down a card and look it over. However, they are warned not to rely on written instructions. Thru remembering the rules, procedures soon become automatic.

A safety precaution — Front door window cranks are often irritating to both the driver and the passenger. They become hazards to knees in case of sudden stops. One respondent requires that the crank be turned upward. He also has found it helpful to have the window rolled up a little above the sill so that a driver is not able to rest his arm with the elbow extending from the car window.

Safety belts — One teacher stops the car suddenly when students have not fastened the safety belts. He then instructs them in the use of the belts. The next time he stops suddenly they can observe how safety belts protect them against being hurled to the floor or thru the windsield.

Checking the position of the seat, mirrors, and brakes — As each student leaves the driver's seat, one instructor has him release the seat as far back as it will go, turn the mirror up, and pull on the hand brake. The new driver must adjust these items and release the hand brake before the car pulls away. Doing this repeatedly helps establish a good habit for cases where more than one person will be driving the same car.

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Summary — Most teachers who wrote descriptions on this topic recommended that student drivers be required to follow specific steps in a prescribed order for entering the car, starting the engine, pulling away from the curb, and leaving the parked car. Usually students first become familiar with these steps in the classroom. These steps are then reviewed, demonstrated, and practiced as part of the first lesson in the practice driving car.

A student is required to do the same things the correct way, and in correct order, at all times when he is driving. As one teacher wrote, "I teach better and the students learn better when I insist from the beginning that everyone follow an exact plan for learning to drive."

Teaching the Efficient Habits and Skills Necessary in the Use of Clutch, Accelerator, Gear-Shift Lever, and Hand and Foot Brakes

A great deal depends upon the first steps in teaching the starting and stopping of a car. A teacher can be judged more or less accurately by how well his students perform in this respect. One of the earmarks of good teaching is the matter of using a car without running down the battery. Many times we have had a large number of learners and all seasoned instructors. Trouble with the batteries being run down has been minimized to the point of probably one or two chargings during the semester. At other times we have had relatively few learners and several new instructors. It then becomes a matter of connecting the charger to the battery daily in order to keep it up to standard. This usually reflects the inability of the instructors to properly teach the clutch and the power point.

—*A college driver education teacher.*

Exercise in car control begins in the classroom — According to one teacher, much car practice time can be saved if instruction on the use of the clutch, accelerator, gearshift lever, and hand and foot brakes begins in the classroom. These basic controls are assigned for study and thoroly discussed before students start practice driving. Thru classroom mimetic drill students become familiar with the position of hands and feet on the controls. The need for operating controls slowly, smoothly, and gradually is emphasized. In such manner the friction point on the clutch is also explained and illustrated. Then these exercises are conducted in the practice driving car. For example:

> Each student manipulates the controls with the vehicles standing and the engine not running. This is followed with a demonstration by the instructor of starting the car in first gear, moving the car forward in first gear, stopping, shifting to reverse, moving the car backward, and stopping. Each student then practices, repeating until he masters control of the friction point and the coordination of hand and foot controls. With the vehicle standing and the engine not running, the student then practices shifting thru the three forward gears. His hold on the gearshift lever is corrected if necessary. Next, a straight line about 150 feet long, extending down a slight grade, is marked off with stanchions. Each student drives along the line shifting thru the three forward gears without using the accelerator, and then backs to the original position. Starting at the other end of the stanchions, students drive uphill, shifting thru the three forward gears—this time with the accelerator. Those who have difficult getting the operations smoothly repeat the exercise.

Helping the student with the dual controls — Another respondent uses the dual controls to teach basic operation skills.

> The first three periods in the practice driving car are devoted to developing student ability to operate the clutch, accelerator, gear shift, and brake controls. The first time a student puts the car in motion, in first gear, his teacher works the dual control clutch with the student's foot just touching the clutch so that he gets the feel of the hesitation point. This is repeated at least twice. Then the driver uses the clutch while the instructor uses the dual control in case of student error. About the fifth or sixth start the driver tries it by himself. All this while, the instructor is stressing control of the accelerator by sound and feel of the car. The words a student hears over and over are "gently," "smoothly," and "evenly." Verbal images help those who have difficulty putting the car into motion smoothly. This teacher tells students to imagine that the accelerator and clutch are the opposite ends of a seesaw; the foot on the accelerator is closest to the pivot, so it doesn't move quite as far as the foot on the clutch. To develop brake control, students practice stopping at designated spots from different speeds. This exercise emphasizes the need for looking ahead. For smooth

stops, they are given the following tip: Just before the wheels stop, ease up on the brake pedal so that the car glides to the point of stop. Then apply the brake.

Giving clear and explicit directions — An instructor's choice of words in teaching practice driving is particularly important. Unfortunately, no standard terminology has been developed. The terms in use, particularly in regard to clutching, may have two opposite meanings. The instructor should select the simplest possible terms and use them consistently. A few teachers emphasized the need for giving explicit directions. One respondent submitted this:

Clutch: Whenever it is put down, put it down immediately all the way to the floor with the left foot. When letting it up, bring it up to the point just under the friction point. Then ease it up until the car begins to move. When the car begins to move, hold the clutch there until the car has gone about two car lengths. Then ease it up gradually the rest of the way. (The foot on the clutch should become so sensitive that the driver can feel with it just as he does with his fingers.)

Accelerator: Letting up the clutch should always be preceded by plenty of gas. Always "feel" the way up or down on the gas pedal. When giving gas before letting the clutch up, make the engine hum, but not roar. A roar means too much gas; a stalled engine means too little gas.

Gear-shift lever: Find neutral by making the lever approximately level. Move the lever parallel to the steering post. Shift to low by placing the hand behind the lever, palm toward the driver. Then move the lever toward the driver's face until it slides into place. Then pull down. Shift to second by placing the hand on top of the lever, palm down. Push forward as far as the lever will go. The lever will not follow a straight path, but a continuous forward pushing movement will put it in second. Then shift to high by placing the hand on top of the lever, palm down; pull down. Shift to reverse by placing the hand, palm up, on the lever; locate neutral; move the lever parallel to the steering post until it hits; move lever away from driver's face—the opposite of first gear.

Footbrake: Always "feel" the way down on the brake pedal with the right foot. If the car is stopping too soon, let up a little. If the car is not stopping soon enough, give more pressure. Gradually release the pressure as the car comes to a standstill and hold the brake just tight enough to prevent rolling. This prevents a lurch as the car comes to rest, and provides a smoothed-out stop with minimum wear and tear. Hold there until the handbrake is set.

How to hold the gear-shift lever — Some instructors teach that the driver's hold on the gear-shift lever should be firm, with the palm down for shifting into all gears; other recommend different holds. One instructor has had success with this: When the car is standing still, the palm of the hand is up. When the car is moving the palm of the hand is down. Thus the lever is shifted into first and reverse gears with the palm up and into second and third with the palm down.

Exercise to develop clutch control — One teacher wrote that he has a student "creep" the car in first gear on a level roadway without using the accelerator or foot brake. This is done by releasing the clutch to the friction point, then releasing it a little more, then pushing it back to the friction point, then releasing it a little more, etc. The exercise is repeated with each student until he is thoroly familiar with the sensitive area of the clutch. It has proved excellent for developing clutch control.

An exercise used by another teacher is: The vehicle is at the curb and the handbrake is set hard. The student is instructed to release the clutch to the point of laboring and at the same time apply a light pressure on the gas pedal. Then the accelerator is released and the clutch is pushed down to the floor. This is repeated until the student can get into the friction point without stalling.

An anti-stalling start for timid drivers — An anti-stalling procedure is recommended by one teacher for those timid drivers who never seem to feed enough gas. This exercise calls for a double gas feed. The engine is started, the handbrake is released, the lever is in first gear. At this point, depress the accelerator quickly then release it. Then release the clutch. Give gas again as soon as the car begins to move. By this time a timid learner will have given the same amount of gas as the normal learner.

Preventing jack-rabbiting starts — Some beginners "jack-rabbit" when starting off. One teacher at-

tempts to prevent this by explaining the stroke of the clutch pedal as follows: The depressed clutch is completely disengaged. Release the clutch to the hesitation point—that point just under the friction point. Here accelerate slightly. Then slowly release the clutch to the friction point. Slowly release the clutch while accelerating. Do not take the foot off the clutch while releasing it the full way. The instructor tells the student when to remove the foot. If the car lurches, the student has released the clutch too quickly or has given too much gas. The remedy is to quickly depress the dual clutch, direct the student to depress his clutch, and start again.

Developing understanding of how much gas to apply — One teacher wrote of an exercise to develop student understanding of how fast the fast idle should be before the clutch is engaged. With the car parked and the transmission in neutral, he has the student listen to the engine while he, the teacher, works the hand throttle or foot feed. He then has the student duplicate this fast idle by the use of the foot accelerator. After this is practiced a few times with the car in neutral, it is an easy step for the student to apply the same technic after shifting into low or reverse and before releasing the clutch. The same teacher submitted an exercise to correct the tendency he has observed of some *boys* to "over-rev" and of some *girls* to "under-rev" the engine in first and second gears. Three different routes are mapped out, each a mile or two long but different in the degree of upgrade. For the level route, the class agrees to shift at seven and 15 miles per hour when accelerating normally. For the route with the slight upgrade, the shift point is raised to 10 and 20 miles per hour. For the steeper route, the shift points are 15 and 25 miles per hour. This exercise seems to impress girls with the idea that the shifting point must vary depending upon the power needed for good performance. It also helps boys to grasp the idea that it is possible to drive away from a spot on level ground with a light pressure on the accelerator.

The other teachers submitted exercises for use on steep grades. These exercises aim to develop hand and foot brake control as well as to perfect clutch control. One of these recommends that when a student first practices on steep grades, the instructor should aid him with the dual control clutch and brake. The student should be allowed to practice by himself only after he has been helped several times by the instructor.

Summary — All of the descriptions submitted here were for use on cars with manual gear shifts. These teachers were in general agreement that this stage of instruction in practice driving is extremely critical. If a student fails to master the coordination of the clutch, accelerator, gear-shift lever, and hand and foot brakes, the development of advanced skills is precluded.

It is apparent here that the exercises a teacher designs may be only as complicated as the ability of a student permits them to be. For students of low ability, it would appear desirable first to provide practice at the curb for each control. Students of high ability can begin learning the coordinated hand and foot operations with the car in motion.

Teaching the Beginning Driver to Steer the Car Smoothly and Slowly Forward and Backward

Beginning students differ in ability to steer an automobile. A great deal depends upon the previous experiences of a student with toy vehicles, bicycles, boats, farm machines, and the like.

Some beginners find steering difficult because they tend to turn the wheel more or less than is needed. One teacher observed that the student who oversteers has the feeling that in driving he must be turning or moving something at all times. Understeering on the other hand may result from failure to give the job complete attention. In addition, pupils who have poor eye-hand coordination have difficulty in keeping the car moving forward in a straight path.

Classroom preparation for steering — Two teachers wrote that their students were given some pre-

liminary work on steering in the classroom. One teacher has found a driving simulator of some help in introducing students to steering. Another uses a driver compartment "mock up" to give them experience in turning the wheel with a hand-over-hand motion.

Selecting the point of reference — Aiming the car for a specific point helps in learning to steer the car in a straight line in the center of the lane according to one teacher. A student is instructed to pick out a point in the middle of his lane anywhere from 100 to 200 feet ahead of him. He uses this as a reference. Altho he aims the car for that point he does not continually stare at it. He looks at it, then glances around, then returns to it. As he approaches the point, his eyes jump ahead to pick up another point in the center of the lane. When approaching curves, his point moves to the centerline or the shoulder depending upon whether the curve goes to the left or to the right. Another factor stressed in teaching steering around curves is that the driver must turn, or arc, as the curve arcs, and straighten as the curve straightens. He is warned not to try to outguess the curve.

Steering practice in an automatic shift car — One respondent allows his students to drive an automatic transmission car in the first lesson. They are taught to steer by looking ahead in the path they want the car to follow — and not at the front of the car or the curb. Backing is taught as soon as a student masters steering forward in a straight course. In order to familiarize a student with the direction the steering wheel is turned in backing left and right, he is instructed to back looking over his right shoulder with his left hand on the top of the wheel. He observes that the car moves in the direction (left or right) that the steering wheel is turned. The same idea, i.e., directing the student's attention to the path the car is to take, is also used in teaching him to steer the car when backing.

Practice away from traffic — Three respondents give initial steering practice on an off-street area or a street which is blocked off from moving and parked cars. In one case students drive on a parking lot until they get the feel of the car. Before driving on the street, they must be able to drive along a straight line marked off with stanchions. This is followed by exercises in driving in a figure "8" pattern both forward and backward using the hand-over-hand turning method. (The stanchions which mark off the figure are gradually brought closer together until the area is as small as possible.) This drill develops a student's ability to steer the car and also is the introduction to left- and right-turn maneuvers. When a student performs well on these exercises, he is advanced to driving in light traffic and there practices right and left turns.

The two other teachers also combine practice in steering forward and backward with practice in turning and stopping.

An exercise to develop steering ability — A teacher wrote of his staff's experiment with one student who had failed to learn to steer thru conventional teaching methods. They decided to put him at the wheel of a foreign sports car, and to push it with another car. Because of the steering ratio of the sports car, the slightest movement of the steering wheel radically changes the direction of the car. As the car was pushed at a speed of about 10 miles per hour on a back road, the student was forced to aim the car. The experiment worked well with this particular student. This teacher concluded that teaching steering might go faster if a practice driving car were available which steered like a sports car.

Correcting a tendency to oversteer — Short range focusing of attention may cause the beginning driver to oversteer. One respondent provides this corrective experience:

> On a road with a few curves he demonstrates how few changes of the steering wheel are necessary to keep the car moving on the right side of the road. As he is driving he emphasizes where the driver's eyes should be focused—down the road in the center of the lane. (This technic helps to develop long-range steering where changes in direction are smooth and gradual.) Then a student drives. During his first trial, the instructor reaches over and controls the wheel. The stu-

dent keep his hands on the wheel to get the feeling. Then he practices without help, while the instructor continues to call his attention to where he should be looking. This exercise usually corrects a tendency to oversteer.

Judging the direction of the wheels — Two teachers wrote that placing a strip of adhesive tape on top of the steering wheel aids students in judging when the wheels are pointed straight ahead. This becomes a reference to guide their steering.

While this method may have limited use in close quarter maneuvering, it may curtail the scope of a driver's attention on the open road. Experts generally agree that a driver's attention should be directed ahead of the path the car is traveling to enable him to anticipate and prepare for changing traffic conditions.

Position of the hands on the wheel — Some teachers insist that all students grip the wheel in a specified position for steering straight ahead and that they use a hand-over-hand method of turning. Other teachers allow a student to grip the wheel wherever it is comfortable for him; however, all teachers agree that the wheel should be held with both hands.

A teacher wrote that he has found that when students are allowed to place their hands on the wheel in the position which is natural and comfortable for them, it helps ease the tension beginners experience when they first move the car. In teaching steering around wide curves, he has found that a beginner does not oversteer if he is told to reach up and pull the steering wheel down with the right hand for right turns and with the left hand for left turns, rather than pushing across the top of the wheel with the opposite hand.

On an off-street area or in light traffic, one respondent uses this demonstration to teach students the desirability of holding the steering wheel with both hands:

> The student is at the wheel and moves the car forward in first or second gear. The instructor directs him to hold the steering wheel with the right hand at the top of the wheel. The left hand is off the wheel. As the car is moving, the instructor reaches over and moves the wheel. The student experiences how little control he has of the car when only one hand is on the top of the wheel. The student is then asked to place both hands on the wheel, (one on either side). The instructor again attempts to move the wheel—this time with much less success. When a student contends that no one riding with him will try to wrest control of the car, the instructor explains that the type of interference he has experienced is similar to that which results when a car strikes an object, a hole, a bump, or has a blow out.

Summary — Those who wrote descriptions of how they teach steering said that these technics are in use: (1) provision of experience in the classroom on simulators or "mock ups"; (2) practice conducted on off-street areas; (3) use of automatic transmission cars for early practice, and (4) the use of additional exercises for students who have difficulty in steering.

No teacher wrote of how he identified, prior to practice driving instructions, those individuals who would have difficulty learning to steer because of lack of experience with wheeled toys and vehicles. It would seem desirable to identify such individuals, to give them information on the principles of focal attention governing steering, and to provide some type of practice in steering before they experience failure in steering the practice driving car.

Teachers differed in respect to the stage of learning at which a student should drive in light traffic. One teacher prefers to start students in light traffic. The use of an automatic transmission car facilitates this practice. Other teachers limit the beginning drivers' experience to off-street areas until a student has advanced in ability to coordinate steering, clutching, accelerating, and braking.

Teachers also differed in how students are taught to steer in a straight path. Some teach that correct steering involves correct focal attention and their students are directed to aim the car at the center of the path ahead.

Teaching the Beginner to Stop Smoothly at Designated Spots

The ability to stop smoothly and with precision at designated spots is one of the more advanced skills in driving. Student drivers have stopped the car many times as part of previous lessons before most instructors concentrate on developing smooth and precise stops. This ability is generally regarded as one of the ways by which drivers who have had driver education can be distinguished from those who have been taught by non-professionals or who have "just learned."

Stanchions used for practice stopping — The first exercise some instructors use to develop smooth designated stops requires stanchions which are lined up across a practice lane. The student driver practices stopping as close as possible to the stanchions without hitting them. When he does this exercise well, he then practices stopping with the front bumper over a line marked on the pavement.

Practice stopping on streets using natural guides — One teacher uses a road lined with poles on both sides. A student first practices stopping so that the pole is lined up with the front bumper. An empty milk bottle is placed on the floor of the car, and a stop is judged smooth if the bottle is not upset. The cue this teacher gives students is to watch the spot where they are going to stop.

The students of another teacher practice precision stops on a little-traveled street. He directs them to proceed down the street and to make frequent stops using trees, poles, lines, and breaks in the pavement as targets for stopping. A driver is first coached thru each step verbally and then gradually allowed to take over without help from the instructor.

Tips for smooth, safe stops — One instructor demonstrates a stopping by constant pressure on the brake. Next he shows a technic for smooth, safe stops:

> The trick is to relax pressure on the brake pedal just before the car comes to a complete stop. Then with just a light pressure on the brake, the car is allowed to glide to the point of stop. Then the brake is applied with sufficient force to hold the car motionless. He warned that much practice is required before students master the technic; but once mastered it does result in smoothly controlled stops.

Another recommended technic is to have students apply the brake with a pumping action. This flashes the brake lights and serves as an added warning to other motorists.

Correcting improper use of the clutch pedal in stopping — When some beginners are told to slow down or stop, their first reaction is to depress the clutch. This neither reduces the speed of the car nor takes advantage of the engine's braking power. When a student has this tendency, one instructor puts on this demonstration:

> On a vacant parking lot or practice area, the student is instructed to drive at 25 or 30 miles per hour. When the desired speed is reached, all of the students including the one who is driving are told to look at the pedals and the speedometer. The instructor depresses the clutch. The students observe that the car continues at approximately the same speed. Then the instructor depresses the brake pedal. Students see that the brake really slows and stops the car. This convinces students that the brake is the first control to be used in stopping.

Summary — Students generally have stopped the car many times before the teacher concentrates on developing the ability to stop smoothly at designated spots. Some teachers conduct the exercise in simulated traffic conditions on off-street areas. Others use real traffic situations on streets where there are only a few moving or parked cars.

Teaching Correct and Safe Right- and Left-Turn Maneuvers

Teaching right- and left-turn maneuvers involves developing a student's knowledge of the path the car should follow and his ability to control the car on turns.

Turning instruction in the classroom — Four respondents recommended that the instruction on

right- and left-turn maneuvers begin in the classroom. One makes turning maneuvers the subject of a class reading assignment. Following this, the explanation and class discussion is made as vivid as possible thru the use of magnetic boards, sand tables, and charts. Student groups prepare explanations and demonstrations of the turns in various traffic situations. Then in the practice driving car, the teacher gives a verbal review of the correct procedures. This is followed by a demonstration, student questions, and practice. Each driver is required to give sufficient explanation of the course he intends to take so that the instructor knows that he understands the maneuver before he attempts it. Then student drivers practice turns from stop streets before turns from thru streets. A beginner is never allowed to exceed five miles per hour on turns. (Other instructors wrote that they require beginners to down-shift before turns.) This instructor has a milk bottle on the floor and students endeavor to turn without tipping the bottle.

Preparing students to meet another car on a turn — How to prepare students to make right- or left-turns and leave room for a car turning from the opposite direction was discussed by four respondents.

One wrote that many of the streets on which his students drive are wide enough for only one lane in each direction. When he notices that a student has failed, or is failing, to make a proper turn, he stops the car with the dual controls (if the street is clear of traffic). He has the student observe that there is no room for another car. This is a convincing demonstration that the path around a corner must be a well-directed course.

Another wrote about how he teaches making left-turns. First he directs a student to drive straight into the intersection. The turn is not started until the car is approximately 10 feet short of the center of the intersection. Then the car is directed into the nearest lane of traffic. Students observe the number of cars cutting the corner at a busy intersection. They soon get the idea that corner cutting cuts off the flow of traffic.

Still another teacher has found that it helps beginning drivers when he places three stanchions in the intersection to mark off the limits of the path of the car. They are removed for more advanced practice.

Position of the hands on the wheel. — A respondent wrote that he tries to make all the basic maneuvers as simple and definite as possible. He teaches that a right- or left-turn takes one complete revolution of the steering wheel. His students use the hand-over-hand method and are told that three tugs of the wheel are necessary to make a right-angle turn. The student counts aloud as he makes the turn, "One, two, three, straighten." This is to remind him that after he turns the wheel three times he must immediately get his hands back to the normal driving position so he can let the wheel straighten up. The palms of his hands are used as brakes to keep the steering wheel from "unwinding" too rapidly.

Integrating safety precautions with turning procedures — In order to integrate safety precautions with turning procedures, a respondent tells his drivers to remember the procedure by two "S's" and two "L's": signal, speed, look, and lane. The first three of these must be done before the intersection is reached. These words are repeated as a part of every turn a student driver makes.

Summary — Instruction on right- and left-turns stresses both the path the car should follow and the procedure for negotiating a turn. Classroom study with visual materials is used to develop student understanding of the maneuver. Safety precautions, such as signalling, adjusting speed, and checking traffic before starting the turn are taught as part of the maneuver.

Teaching Precision Maneuvering in Close Quarters

The skills acquired in the beginning practice driving lessons are all fundamental to developing a student's ability and judgment for maneuvering the car in close quarters, such as is required for turning around, angle parking, entering and leaving stalls, garages, driveways, etc.

The foundation for precision maneuvering — The foundation for precision maneuvering is laid at the beginning of the course when students learn to creep the car slowly forward and backward. Control of the car at low speeds is emphasized regardless of the type of transmission on the practice driving car. This involves proper brake use from the very first lesson in addition to accelerator control. When an automatic transmission car is used, the problem is to develop student understanding of the right amount of light pressure on the accelerator required to inch the car along. Here students practice locating the motion point on the accelerator. When a standard transmission car is used, control of the car at low speeds involves developing a student's mastery of the clutch friction point. One instructor wrote that his students are taught to hear, feel, and see the exact time when this point is reached in releasing the clutch. They learn to hear the motor pull down a little, to feel the car vibrate slightly, and in some cars, to see motion as the landscape near the car seems to move.

The roadway or "Y" turn — An instructor wrote that the roadway or "Y" turn is demonstrated at least twice for each carload of students. Before a student tries the turn, his attention is called to the fact that he will be going uphill, then down, on each forward and backward movement. During the turn, the student inches the car. His left foot stays on the clutch, and he never lets the clutch out much beyond the friction point. He is taught to reverse the direction of the wheels at the end of each move, turning them in the direction the car will go in the next move of the maneuver. These student drivers are started on a wide, level street and progress to narrow, crowned roads.

Angle parking — For angle parking one teacher stresses the importance of positioning the car well out in the street before the turn is started. A student first practices stopping and shifting into first gear before the turn. Then the car is turned slowly into place, with the clutch being used to control speed. Later the student practices entering the angle parking space without coming to a full stop before turning in. Instead he downshifts to control the speed of the car. In backing out, he is required to inch the car until he can see down his side of the street. He then continues backing and begins to turn wheels to the right until the front end of the car is in the street. He is then directed to begin straightening the wheels as part of the backing movement.

Entering and leaving a garage — The students of one instructor practice putting the car in an old garage with a narrow doorway. The driveway is up an incline and around a curve lined with bushes. This maneuver requires a high degree of clutch control. Each student puts the car in and backs it out at least twice. After this practice a student has little fear of putting a car in any modern garage.

Summary — Exercises in precision maneuvering in close quarters depend upon, and at the same time reinforce, previous learnings in clutch control, distance judgment in relation to near objects, and accurate steering. In teaching these maneuvers, the instructors who wrote descriptions on this topic indicated these students did not have much difficulty if they had mastered the fundamentals from the beginning lessons.

Teaching Parallel Parking

Parallel parking is considered one of the more difficult maneuvers in driving. It is usually not taught until toward the end of the practice driving course when students have advanced to a degree of proficiency in judgment and ability to maneuver the car.

Preparation for parallel parking — In the classroom one teacher uses several miniature automobiles and a model area painted on a board. Students practice placing the miniature cars in the proper position and guiding them thru the maneuver before they practice with the dual control car. The teacher has found that his classes perform with less effort in the practice driving car since he initiated this indoor exercise.

Driving exercises precede parallel parking — As

an introduction to parallel parking, one instructor has his students weave the car slowly forward and backward thru a course marked with stanchions. This exercise develops and tests the speed control and judgment required to direct the car in turning and parking maneuvers. Another instructor wrote that he returns students to this exercise when they have difficulty mastering parallel parking.

Practice using simulated parking situations — Most of the teachers who wrote descriptions on this topic advised the use of out-door guides such as stanchions, flags, or boxes to simulate parking situations for initial practice and before attempting to park between two real cars.

One instructor wrote that his students start practicing between stanchions set out from a curb constructed on school grounds. At the start of the exercise, the parking space is marked off a few feet longer than the regulation space. He demonstrates once with the students in the car and again with them watching from the curb. Then each student attempts the job with the help of the instructor. The observers watch from the curb. After a student knows the basic steps, the instructor joins the observers and the student is allowed to go thru the maneuver alone in the car.

Another respondent wrote that, simulated parking situations, so reduced the danger element that students were relaxed and better able to develop timing and control for the maneuver.

Placing the car in position for the maneuver — The students of one respondent are instructed to begin driving into position when the driver first sees the car behind which he will park. Since the driver may have to correct his position as he approaches the car, he is advised to shift to second gear about thirty feet before he comes to a full stop parallel to the car ahead of the parking space. Students are taught to signal to other drivers their intent to park by the position of the car, and by hand and electric signals. Parking with safety and courtesy is stressed. Beginners are warned not to attempt the maneuver unless they have had sufficient time to align their cars parallel to the cars behind which they are parking.

Backing with the wheels turned right — The teachers who wrote on this topic agreed that the wheels should be turned hard to the right as soon as a student starts backing. The car is "creeped" slowly backward. One instructor teaches that the wheel should be turned as far to the right as it will go by the time the driver has backed three feet.

When the wheels are turned left — The backing movement to the right is continued until a reference point is reached. On what point to use, there is wide disagreement among teachers. Some emphasize that the direction should be reversed to the left when the car is at a 45-degree angle to the curb. To help the student driver judge when this angle has been reached, one teacher puts a strip of adhesive tape on the top of the instrument panel at a 45-degree angle to the axis of the car. When the tape is pointing straight down the road, the steering wheel should be turned sharply to the left. Other teachers use the same idea but prefer to have a student develop his own judgment of when the 45-degree angle is reached.

Another instructor teaches a student to begin straightening the wheels just before the car passes the left rear bumper of the car ahead. When the car has moved a few inches beyond the left fender of the car ahead he is taught to turn the wheels sharply to the left and continue backing until the car is parallel to the curb.

One teacher recommends placing a strip of adhesive tape vertically at the lower center of the back window. A student is directed to back, holding the wheel turned sharply right until the car behind the parking space appears in the rear view mirror to the left side of the tape.

Centering the car in the parking space — Any fault in the maneuver usually leaves the car not quite centered in the parking space. Most teachers recommend that the student move the car slowly forward

or backward and straighten the wheels until the car is centered in the space and is within the required distance from the curb. Others recommend that the driver leave the wheels turned left to facilitate leaving the parking space.

Summary — Teachers agree that parallel parking is a difficult maneuver to teach. However, teaching is easier if it is postponed until near the end of the course when students have gained experience in maneuvering the car with precision at slow speeds. Some teachers have found that preliminary classroom and car exercises are helpful in teaching the actual parking maneuver.

There is no disagreement among teachers on how to direct the initial steps of the maneuver. There is disagreement on the procedure which best develops a student's knowledge of when to reverse the direction of the turn in the backing movement. Therefore, the new teacher should be familiar with all of the methods in use and select the one which he can use best with his students.

Teaching Students the Technics of Driving in City Traffic

It is hard to tell a student what driving in city traffic is like. The best a teacher can do is to guide him in forming a reference of safe and good driving habits and attitudes from which he can make the quick and correct decisions required by rapidly changing, multi-faceted city traffic. And the teacher reinforces this with guided practice in city traffic driving.

Developing ability to drive in city traffic — Developing the ability of students to drive in city traffic is the goal of one driver education teacher's course. A film on city driving is shown and discussed. Then students make surveys and observations of city traffic. In the car experience in light traffic areas is given before experience in heavy traffic. The instructor tries to instill such confidence in a student that he will ask to drive in heavy traffic. While a student is driving in heavy traffic, the instructor works for a relaxed but alert atmosphere. He has found that driving in city traffic makes a much more confident driver.

Driving in local traffic — One respondent does not have a student attempt to drive in mid-town traffic until he can handle the car well. The narrow and winding road into town demands emphasis on staying on the right side. The route thru the city is planned to include streets with two sets of car tracks, two lanes of parallel parked cars, and two lanes of moving traffic. There are pedestrians darting out between parked cars, trucks double parked, and cars skidding on car tracks. They have the main street and side streets from and into which the driver makes right and left turns. The instructor has to be constantly alert. He must see that the driver is aware of all the possible accident potentials in the path of the car. Students learn a great deal in this lesson and when it is over have a sense of accomplishment and confidence.

Providing experience in city traffic driving for rural area students — When the local area does not have congested traffic, one teacher suggests this experience: A student must have demonstrated his ability to handle the car well. Further, he must make the instructor feel at ease while he is driving. Highway and city traffic are combined in one lesson. The student drives the main highway to nearby towns where traffic is heavy. There are hills, narrow streets, main street parking, and stops for traffic lights on hills. Former students have told him that city traffic has not bothered them after this lesson.

Summary — Two descriptions here told about how teachers provide city traffic experience. Another outlined steps in classroom and practice driving which develop the ability and desire to drive in city traffic.

The degree of traffic concentration planned for a student should be governed by his progress and ability. Generally, teachers prefer to start students on an off-street area on a blocked-off street, or in light traffic. A student progresses to increasingly heavier traffic as he develops skill and judgment. The rate at which he advances depends upon his own

ability and maybe upon the type of car used for teaching purposes. One college instructor believes that more can be accomplished when an automatic transmission car is used.[10]

Teaching Students the Technics of Open-Road Driving

Open-road driving seems relatively simple when compared to city traffic driving. Yet the number and severity of accidents which occur on the open road indicate that the task requires more attention and technic than many drivers are giving it. Instruction in open-road driving is designed to demonstrate the amount of attention needed and provide experience with the appropriate technics. Also it helps beginning drivers develop confidence. This instruction deals with speed control and attention to the physical conditions of the road, to weather, posted regulations, and other vehicles and pedestrians.

The teachers polled in this survey did not say what type of open-road experience is provided, when a student is judged competent to qualify for this experience, or where in the course this instruction fits into the plan for advancing students from simple to complex traffic situations. Specific phases of open-road driving are discussed in succeeding topics in this section and in, "Developing Accident-Free Drivers."

Teaching Students How to Pass Other Cars with Safety and Courtesy

Passing is one of the more dangerous maneuvers in driving. Poor judgment in passing is a frequent cause of accidents. Safe passing requires the accurate assessment and judgment of many factors from the decision to pass to the completion of the maneuver.

Practice begins on a divided highway — A teacher wrote that he begins passing instruction on a four-lane divided highway. Here, a student driver is able to enter the passing lane without danger of meeting another vehicle head-on. At the same time he can see the on-coming traffic. Both driver and observers get experience in judging if the pass is safe. A student makes his decision to pass, passes, and then can see if the pass was completed before the on-coming vehicle and the practice driving car potentially met —in different lanes in this case. The respondent believes that this is a realistic, safe, way to start developing the judgments required for passing.

Using two practice driving cars — Before allowing students to pass in an actual traffic situation, one school staff provides experience in passing and being passed using two driving groups in two practice driving cars. Each student passes the other practice driving car at least twice. This gives a student the opportunity to test his judgment and ability in a relatively safe way. Of course, he is warned that some drivers will not cooperate as well as the driver of the other practice driving car.

Errors in passing common to beginning drivers — During the classroom lessons in passing, the students of one respondent seem to understand the steps in proper sequence. However, the first time actual passing is tried, all of them are nervous and unsure. Certain faults are characteristic of beginning drivers: (1) they lack judgment of the time required for the pass; (2) they do not make the necessary safety checks before and during the passing maneuver; and (3) they return to the right lane too soon after passing.

Consequently, some of the material already covered in the classroom must be repeated and stressed. Hypothetical passing situations are analyzed. Examples are given, such as the time and distance involved when a driver traveling at 40 m.p.h. overtakes and passes a car traveling at 30 m.p.h. Then in the car, the students' attention again is directed to the necessity of watching for approaching cars thruout the maneuver. Also a beginner is drilled in taking a quick glance in the left side exterior mirror or over his left shoulder before he enters the passing

[10] Leslie R. Silvernale. "Driver Education in Michigan Schools," *College of Education Quarterly*. East Lansing: Michigan State University. 2:2. April, 1956. p. 15-18.

lane to be sure that no car is overtaking him. To correct the tendency to cut back into the right lane too soon, he is told that he should be able to see the passed car in his rear view mirror before he begins to return to the right lane. A quick glance in the mirror is emphasized since the driver's attention must be directed primarily toward the forward path of the car.

Summary — This section described how teachers make the initial passing experience realistic and safe. One of them reviewed the errors which beginning drivers are likely to commit. Obviously the passing maneuver represents the apex of the driver's combined skill of distance-speed judgment and vehicle manipulation. These skills can and should be introduced in the classroom, but can not be perfected without actual practice.

The development of the skills required for safe passing begins the first time the learner starts, moves and stops the car. In successive lessons he gains experience in increasingly complex driving situations until at the end of the course he should be competent quickly to appraise the situation and know whether or not it is safe to pass.

Teaching the Student How to Apportion His Attention

> A good driver, like a fly, sees everything around him. The theory that the eye must be glued on the pavement is fallacious. It is hazardous to keep the eyes fixed on any given object for a period of time. Nature requires movement of the eyes to reduce strain. A safe driver must see and evaluate everything in his direct field of vision.[11]

The road ahead, the road behind, the right and left sides of the road, and the panel controls all require the attention of the driver. An underlying cause of many beginning drivers' difficulties is that they fail to apportion their attention correctly. Experts advise that drivers use the scanning method—keep the eyes moving! Two teachers described how this is taught.

The beginner focuses on details near the car — One instructor has observed that some beginning drivers tend to fix their attention on details near the car. To discourage this practice, he emphasizes these points developing comprehensive vision: (1) The driver's line of vision should be at least two inches above the steering wheel (Cushions should be used when necessary to elevate the student); (2) A student is instructed to glance well ahead at the center of the driving path and to allow his lower peripheral vision to take care of the ground near the car and the panel controls; (3) Then a comprehensive watch over objects far and near, along both sides of the road, and to the rear (thru the mirror) is achieved by moving the eyes constantly.

This teacher has observed that these practices are not developed quickly but come along gradually as the learner's responses become more and more automatic. However, a teacher can facilitate this development by explaining in the classroom the visual practices of good drivers and the reason for these practices and then, in practice driving lessons insist that they be followed.

A black-out screen for levers and controls — After a hair-raising experience with a beginner who could not keep his eyes off the panel controls and on the road, one teacher developed a black-out screen. The device is used following the instruction in gear shifting When it is in place on the steering wheel of the car, all of the manipulation must be done by touch and feel. It is easily removed when a student has mastered the controls.

This instructor has used a screen with 90 high-school students and nine adults. He feels that it helps students keep their attention on the road. It shortens the time required for shifting to become an automatic response. Steering and judgment show immediate improvement. Also students are forced to grip the steering wheel properly. While the initial reaction

[11] *Driving Laboratory News*—Iowa State College, Ames, Iowa. November, 1952.

of students to the screen was negative, all except two expressed satisfaction with it after having used it.

Demonstrating the blind spot in the rear view mirror — To show a skeptical student how large an area is not covered by the rear view mirror, a teacher has him stop the car beside a parked school bus. Usually he is surprised to see how much of the bus is obscured.

Summary — One teacher described steps taken in the classroom and practice driving car to develop a student's understanding of and ability to use the technic of shifting visual attention. Another teacher described a black-out screen he developed to fit over the steering wheel, hide the levers and controls, and facilitate the development of automatic responses. Thus, a student's ability to apportion his attention correctly is gradually developed.

VI. DEVELOPING ACCIDENT-FREE DRIVERS

The mounting toll of accidents has focused public attention on the problem of accident reduction. In the solution of this problem, automobile design, highway improvement, and traffic enforcement are important. Of greater importance are the education of beginning drivers and the re-education of experienced drivers.

Formerly, safe driving, if thought of at all, was considered something that came with experience, even if not to all drivers. It is now recognized that a driver education course can help an individual recognize situations which might lead to accidents, know how to avoid such situations, and accept responsibility for doing so from the beginning of his career as a driver.

Developing an Awareness in Beginning Drivers That Most Accidents Can Be Prevented If Drivers Are Alert to Potential Accident Situations and Make the Proper Compensating Maneuvers

> Even where accidents seem to be occasioned by chance circumstances only, one must not overlook the fact that chance circumstances are responded to by the individual and that the nature of his response, and consequently the avoidance of an accident, will depend on certain personal qualities.[12]

Classroom study of local accident accounts — One teacher's students prepare scrapbooks containing newspaper clippings of accounts of automobile accidents. Under each clipping a student writes his analysis of why the accident occurred and how it could have been prevented. He soon realizes that the headline "Rain Causes Collision" really indicates that a driver failed to alter his driving to meet conditions, and that "Car Skids on Curve" means that a driver failed to slow down enough when approaching the curve. Thru making such a scrapbook, a student becomes more adept at analyzing the cause of accidents and suggesting preventive measures. He becomes accustomed to thinking of accidents as "driver failures" instead of as resulting from chance circumstances.

Another teacher has a file of accident clippings which describe typical situations. As a part of the instruction on traffic citizenship, each student is given a clipping and asked to make a drawing of how the accident took place, to list possible traffic violations involved, and to suggest the factors which, if known and put to use, would have prevented the accident. This kind of learning helps students understand that every accident involves not only violations of traffic laws but also violations of those sound driving practices which are a part of the driver education course.

On-the-spot teaching in the practice driving car — One teacher observed that the beginning driver is sometimes so intent and absorbed with the task of driving that he forgets his classroom instruction in accident prevention. Here is an example of where "on-the-spot" teaching can fortify classroom instruction:

> A student is driving down a narrow street; cars are parked parallel to both curbs; another car, double-parked, obstructs the path of the practice driving car; and vehicles are approaching in the other lane. His instructor notices that the student driver gets a determined look on his face. So the instructor directs him to stop behind the double-parked car. "On-the-spot" teaching is helpful now because the student is aroused and indignant. Here the instructor analyzes with the group the accident potential of the situation and how it is increased thru the emotions which are generated. While the original violation is charged to the driver of the car which is double parked, the discussion which

[12] Herbert J. Stack, Elmer C. Siebrecht, and J. Duke Elkow, editors. *Education for Safe Living*. New York: Prentice-Hall, Second Edition, 1949. 447 p., p. 53.

follows clearly establishes that the accident prevention responsibility now belongs to the student driver. In this case, unless he passes the car with care, he increases the accident potential of the situation.

Summary — In the classroom, students study accounts of local accidents and learn to analyze the individual failures involved rather than attributing them to chance or adverse driving conditions. In the practice driving car, they learn judgment in controlling the car and their tempers thru experiences that arise as they drive. They learn how to accept the responsibility for preventing accident-potential situations from developing into accidents. As one respondent noted: "This topic is of utmost importance in the driver education curriculum and is one which we stress continually."

Teaching Students the Concept of Safe Speed, Including the Need to Adjust *Driving Speed and Visual Attention to Changing Road Conditions*

Students are taught that a safe speed is dependent upon all the personal and environmental conditions which affect driving. These include: the road, traffic conditions, weather, visibility, time of day, the car and the driver.

The theme of one respondent's instruction on this subject is "proper mental adjustment to driving variables." A problem in his area — he teaches driver education to students in a teachers college — is that a large proportion of the accidents occur on rural secondary roads. Reports indicate, however, that the drivers involved were somewhat familiar with the roads they were traveling, but did not appreciate the need for reduced speed and increased attention when driving on these roads.

This problem is discussed frequently in the classroom. Then students are given the opportunity of driving from hard surface roads on to gravel roads so that they can experience the different control factors which driving on these roads requires. They quickly perceive what is different about driving on secondary gravel roads, roughness, less traction, ruts — and realize the need for speed control and alertness. This instructor also stresses the need to locate all controls before driving a strange car. He uses an illustration which is familiar to the campus. A student who was driving a friend's car groped for the radio dial and failed to notice a curve he was approaching.

The effect of wind pressure on the side of the car is also discussed. In practice driving, if the weather cooperates, students drive in high winds so they can experience the steering problems when wind pressures change due to passing cars, hills, trees, embankments, bridge abutments, etc.

Developing Habits of Awareness to Danger Spots

New drivers may learn to recognize those places on the road which are more dangerous than others. Intersections, curves, crowns of hills, road-side businesses, streets lined with parked cars, etc., all serve the alert driver as cues to reduce his speed and to increase his attention.

Responsibility for accidents — As part of his initial development of defensive driving tactics, one respondent explains to the students that when two drivers are involved in an accident, both are usually at fault. Tho one driver may be more responsible than the other, both share responsibility for the accident. This responsibility can be assumed by anticipating thoughtless and dangerous actions on the part of other drivers, particularly at places on the road which are known danger spots. Thru this kind of instruction, driver education teachers help students to understand that the right of way in traffic is not one of those personal or social rights for which it is honorable to die.

Class study of potential accident situations — As homework, the students of one respondent illustrate graphically five potential accident situations. Each student explains his situations to the class. Then, with the help of the magnetic traffic board, each situation is discussed and analyzed in terms of the safe practices a driver would need to use.

Using problems suggested by local driving situations — A respondent who teaches driver education to students in a teachers college discussed the use of local situations in stimulating students to form habits of perceiving environmental and human factors which set up accident-breeding situations. When a student is driving, this teacher frequently suggests a problem, such as, "What would you do here if such-and-such happened?" The driver outlines the actions he would take. Then the following discussion emphasizes that part of the driver's continuing assessment of conditions should include an evaluation of avenues of preventing potential accidents. He should know in advance if he can drive into the shoulder of the road if that should become necessary. Each of these problems is referred to again when the class happens to observe what another driver is doing in a similar situation.

This type of problem solving is carried over into a student's out-of-class experiences. The teacher can observe that his students are assigning a new meaning to what they see as they drive. Invariably these students devote a part of the first class periods of the week to a discussion of the driving situations they witnessed over the weekend. A student frequently sums up his account by saying, "I never realized what that meant before."

Another teacher uses a similar technic. He has made slides and short motion pictures of local hazardous situations, including intersections, crowns of hills, streets lined with parked cars, and road-side businesses. His class briefly views each slide or motion picture. Then students are asked to write down each possible hazard, illegal motion, and those movements or objects that would interfere if they were driving. Then discussion is carried from the classroom to the car where the student sees the same hazardous situations he viewed on the screen. Frequently the instructor stops the car and has a student name all objects to the front, sides, and rear. He lists the objects, he gives an evaluation of each in terms of whether it could become a source of danger. Problems are also flashed to the driver: The instructor asks, "What would you do if——?" or "How would you know if——?" These methods are used to develop insight — to help a student observe and evaluate all objects in advance. The teacher has noted that toward the end of the course his students begin to suggest items that they see and to use their imaginations about objects which might create emergency situations.

Summary — The teachers who wrote on this topic were relating technics used at different stages of student learning. One teacher used films and slides of local driving hazards. Problem solving in the practice driving car was used by two teachers to develop in their students the abilities to avoid emergency situations and to respond correctly if caught in such situations. Another technic for developing insight into accident provoking situations was suggested by the teacher who schedules time during the first lesson of the week for a discussion of weekend experiences.

Aiding the Student to Form Habits of Recognizing When Another Driver, Pedestrian, or Cyclist Is Creating an Accident Situation

The well-prepared driver looks for clues as to the other fellow's moves. Thru attention and control of speed, he can be prepared to adjust to the unexpected actions of other drivers, pedestrians, and cyclists. In a driver education course, beginners learn to recognize when someone is creating an accident situation. They also learn how to make proper compensating maneuvers.

Developing ability to size up other drivers — Both in the classroom and in practice driving, one teacher stresses that no one can read another driver's mind. However, thru observations, a driver can pick up clues to the other fellow's driving habits and learn to be alert for what they may do. His students are taught to observe another driver in terms of whether he is erratic, cautious, taking chances, sportsmanlike, in a hurry, etc. While driving, the students observe the behavior of drivers ahead of and behind the practice driving car. They practice judging the other

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driver's behavior in determining their actions in following, passing, or stopping. For example, when a student observes that the driver behind him has difficulty in steering in the center of the lane, the student suspects him of not giving full attention to driving. Consequently, before stopping ahead of this driver at an intersection, the student flashes his brake lights far in advance of the stop and gives an emphatic hand signal, too. From his students' discussions of their personal experiences as drivers and passengers, the teacher concludes that students make good progress in driving defensively when such procedures are used in practice driving instruction.

Study of specific illustrations — In the classroom specific situations are discussed to illustrate where foresight is needed in driving. Then during the practice driving session, a student's attention is directed to actual instances occurring in traffic which will develop his ability to analyze characteristic motions of drivers and pedestrians on the verge of an accident situation. Examples of these specific situations are: (1) When a ball rolls into the street, you may expect a child to chase after it. (2) When you see a pedestrian ahead signaling for a taxi which is in the lane to the left of your car, you may expect the taxi driver to cut in front of your car. (3) When a person is sitting behind the wheel of a parked car, you can assume that he will open the door or pull out into the street.

Alerting other drivers — One respondent emphasizes signaling as a part of defensive driving. Some of his tips are: (1) When you are going to turn, gradually maneuver into the correct lane far in advance of the turn (Your maneuver itself is one of the signals alert drivers look for); (2) Prior to signaling for your turn, a light tap on the brake pedal flashes a warning to the driver following you that something is going to happen; (3) When a situation ahead might require a stop, flash the brake lights to alert drivers behind you; (4) in night driving, flick the headlight dimmer switch to signal your intention to pass. Signaling takes on a new meaning and importance when a student learns how it can be used in defensive driving.

Demonstrating how children react in traffic — When one instructor is driving the practice car and sees a group of children playing in or near the street, he demonstrates how children react when they hear a horn and see an approaching car. By blasting the horn at the group from a safe distance they observe how many children halt or turn around and recross the path of the car. This convinces student drivers that the only safe thing to do when a child is playing in or near the street is to slow down long before reaching him. The sound of a horn at close range may startle a child and cause him to turn right into the path of the car.

Another teacher, in teaching driver responsibility, has students cite instances of how carefree children behave and how the careful driver can assume responsibility for their safety. In the latter part of his course, this instructor has the student driver pass by an elementary school near closing time. In the classroom he has been impressed with the potential dangers. If he has to hit the brake suddenly to avoid striking a child, he sees how quickly a dangerous situation involving a child can develop.

Summary — In the classroom the most effective procedures appear to evolve from class discussions of personal experiences or of specific situations outlined by the teacher or students. In both cases, discussion is based on material within the realm of the student's experience. They have seen the things discussed take place. In discussions teachers endeavor to bring out aspects of the situations that will help students in their driving. Then in the practice car, students are guided to relate clues from the environment and driver or pedestrian behavior to their speed and control of the car. They learn to avoid entanglement in accident situations.

Preparing Students to Drive Under Hazardous Conditions, Such as on Icy or Slippery Roads, Thru Rain, Snow, Fog, High Winds, etc.

The ordinary technics of starting, shifting, accelerating, braking, and steering must be considerably

altered for driving on icy or slippery roads, thru rain, snow, fog, and high winds. Weather often provides a combination of hazards with poor visibility frequently another complicating factor.

Preparing beginners to drive under hazardous conditions taxes the ingenuity of the driver education teacher. Furthermore, these lessons are impossible to schedule.

Demonstrations in the classroom — One instructor demonstrates skid conditions by using a mock-roadway and a model car with front wheels which turn. The roadway is constructed to include turns and inclines, and has a hard surface bordered by rough shoulders.

A class discussion points up the tendency of some drivers to jam on the brakes and turn the wheel violently whenever an obstacle suddenly appears before them. This means that a slippery road or at too high speed, the car will keep on sliding toward the obstacle. (This is demonstrated in the practice car whenever possible.) With the materials described above such an occurrence is demonstrated without hazard for all the students in the class. The model car is run down the slope with the front wheels turned slightly; the students see that the car steers normally. On the second trial the front wheels are jammed so they do not rotate altho they are turned hard for a left or right turn. Despite the direction of the wheels, the car slides straight down the hill. To further demonstrate what happens when the car skids, the instructor pushes the car and at the same time turns the steering wheel against the direction of the push. The students observe that the car continues in the direction it was pushed. Such demonstrations illustrate the laws of nature operating when traction is at a minimum.

Experienced skidding — An experienced teacher has each of his students drive at approximately 10 miles per hour on a street where there is no other traffic. Suddenly the student is directed to slam on the brakes. When he actually feels the motion of the car in this controlled situation he is better prepared to understand skidding.

Classroom and car lessons on bad weather driving — Two teachers reported the classroom and practice driving experiences they use to prepare students to drive under hazardous weather conditions.

One of them bases the first lesson on material in the text. They discuss different weather conditions, the problems they create, and the solutions. Then, for homework, students ask experienced drivers of their acquaintance how they have coped with snow, ice, winds, etc. The assignment always results in some vivid accounts of personal experiences. In both the classroom and the car lessons the technics of steering, accelerating, turning, braking, and using the headlights are discussed to point out that in hazardous weather normal technics must be modified.

When the opportunity arises during a scheduled period students gain experience driving under hazardous conditions. If visibility is poor, daytime use of parking lights and, in some cases, driving lights is advised. On windy days, the location of lessons is changed so that students can experience the difficulty of controlling the car on the open road. Even beginners drive in ice and snow. Whatever experiences the weather conditions may provide are utilized thru this teacher's flexible lesson plans.

The other teacher who wrote on this subject said that after he has explained what the hazardous conditions are and when and where a driver may expect to encounter them, the subject is turned over to the class for discussion. Altho this discussion is based on specific problems he has set up, his students do most of the problem solving. Then they view a film on how to drive under adverse conditions. Afterward, the solutions developed by the class are compared with the solutions offered in the film. This teacher also conducts practice driving in all kinds of weather. He has found that after the first lesson, students who resist driving on ice and snow agree that the experience was worthwhile.

Summary — The three teachers who wrote on this subject agreed that actual experiences in driving in various kinds of weather should be provided whenever possible. Demonstrations in the classroom, stu-

dent problem solving, viewing films, and oral accounts of personal experiences are used to prepare students for hazardous weather driving.

Preparing Students to Make Proper Maneuvers in Cases of Blowout, Brake Failure, or Other Mechanical Failure

One teacher described his instruction of blowouts:

> A series of classroom demonstrations makes the lesson realistic. The objective is to prepare students to identify a blowout by its sound, to know what steering difficulties to expect, and to know how to act in case of a blowout. First he demonstrates the characteristic sounds of a blowout. Consequent maneuvers of the car are demonstrated with model cars. Separate demonstrations are given for blowouts on each of the four tires. The students see a rear tire blowout will sway the car from side to side; if the right front tire is involved, the car will swerve right; if the left front tire blows out, the car swerves left. They see that violence of movement and the danger involved depend upon the speed the car is traveling. Four rules are given to guide students in case of blowout: (1) Keep control of yourself; (2) Keep your foot off the brake pedal; (3) Gradually let up on the accelerator; and (4) Keep a firm, steady grasp on the steering wheel.

VII. TEACHING DRIVER EDUCATION TO SPECIAL GROUPS

According to the recommendation of the National Conference on Driver Education, "Instructional methods should be based on the needs and interests of particular groups of students and of individuals within each group, as well as the over-all environment or social setting in which the students live."[18]

When a class has individuals with prior driving experience, varying abilities, and particular mental or physical problems the program of instruction must meet all these needs. In addition some schools are also offering driver education to adults, out-of-school youth, and/or experienced drivers referred for re-education by a traffic court.

Making the Instruction Profitable to a Class Which Includes Both Experienced and Inexperienced Drivers

Instruction and practice that is interesting to a beginner may not hold the attention of a student who has driven — even tho he might learn much from the course. One teacher commented that the major problem here is to keep an advanced student involved learning things he does not already know and yet make him feel that he is not only a part of the class, but a leader, and a valuable assistant to the instructor.

Providing for experienced drivers — A respondent has observed that even when all his students start the course as beginners, some will be relatively more advanced than others after a few lessons. Consequently, it is to be expected that licensed drivers will vary in driving ability.

Most of those who wrote on this topic felt that licensed drivers should be given a road test at the beginning of the course. Then lessons can be planned for the individual driver at his own level of integration. One teacher noted that most students who came into the course as licensed drivers still had a great deal to learn about correct and efficient maneuvers, safe driving, and smooth driving.

One school has a special program for licensed drivers. These students take the regular 30 hours of classroom instruction. In addition, three hours of practice driving instruction are given individually — one student in the car with the instructor. The driving period consists of one-half hour of driving and 15 minutes of practice to correct mistakes or to confer with the teacher.

Stimulating interest in fields related to driving — Students who are advancing rapidly or are experienced drivers are encouraged by one respondent to make their own driving course — to go beyond the minimum requirements of good driving. This teacher tries to stimulate these students to become interested in engineering, designing, or any of the other fields related to highway transportation. If a student is interested, he and the teacher work out supplemental projects to further his knowledge of the related field.

Using student assistants — Several teachers reported that they used experienced drivers or advanced students to help in certain phases of the instructional program both in the classroom and in practice driving. One wrote that he welcomed their help because he has found that experienced drivers can be important resource people, and at the same time will learn a great deal as they assist others. However, they are used only in situations where they can be carefully supervised. A student assistant usually is given extra preparation in the phase of the program with which he is to help. The respondents reported that these students assist with: operating audio visual equip-

[18] Opt. cit.

ment, changing tires, putting on chains, checking oil, water, and tire pressure, and general maintenance of the practice driving car; operating the parking of student cars on the school parking lot. Students who display leadership qualities can be appointed leaders of discussion groups or of groups making traffic observations or other field surveys. One respondent said that one or two advanced students will stimulate the others in the driving groups to greater achievement.

Summary — Teachers find that they have few problems with experienced drivers when they are convinced that there is much they still can learn about driving. These students are made to feel that they are an important part of the course in the role of student assistants to the instructor, and thru undertaking advanced projects in driving or the study of a related field of interest. The respondents enumerated specific tasks which these students can be prepared to do to be of real help to the instructor.

In addition to the tasks mentioned by the respondents, the National Conference on Driver Education suggested that student assistants, with careful selection, special preparation, and supervision, could sit beside the learner in the car and safeguard his practice of skills on an off-street area and after initial instruction by the regular teacher.[14]

Helping the Tense Student

Many students who have never driven before will be tense. However, one teacher has found that 95 percent of the beginning students, tho nervous at first, become relaxed after five lessons. Girls are more likely than boys to have this problem, and tense students are particularly aggravated by derision from the other members of the driving group.

Setting the standards for group behavior — Prior to beginning practice driving instruction, the teacher should have a discussion with the students to develop a spirit of cooperation among them. Criticism offered in the right spirit can be a stimulating element in group work, especially if students also have their attention directed to the value of encouraging any student who may have difficulties. Some discussion is not directed to the problems of any one individual in the group. It is general in nature and helps to set standards for student behavior toward others. One respondent wrote that the encouragement a tense student receives from other students in the driving group is probably the most important factor in relieving his tension. Another instructor has found that an exceptionally tense student does better if taken alone in the car at least until he can start and stop it.

How the instructor can act to relieve tension — Three respondents offered similar suggestions concerning how to act toward a student who is having a tension problem. They agree that he is helped most when the instructor is relaxed and when his voice is calm and low. He should not use a scolding tone; he should not permit the students' errors to irritate him and should continue to encourage them. He should find some aspect of each student's performance in each lesson to praise. One respondent wrote that while a teacher may expect outbursts of tears, temperament, or profanity, he should not appear shocked. When the outburst is over, the individual is usually much calmer. By letting a student know that this is not unusual, the teacher frequently can alleviate the problem. This technic removes the possibility of the student using the problem as a "claim to fame" — a way of getting attention.

Planning the early lessons for the tense student — For the tense student a slow, confidence-building procedure works best. The instructor talks to him before he starts a maneuver, then has the student tell what he is going to do. The instructor does not proceed until a student is confident that he understands what is required. Should the student become upset over a failure, the instructor has him stop and return to something he understands and can do well — even if it is just naming the instruments on the dashboard. Another teacher has found that a short conversation about something trivial will often help a student regain his poise.

[14] Ibid.

One respondent has found that the tense students progress more rapidly when instruction is started on an automatic transmission car. They can return to the manual shift later in the course. If a student shows tension when the instructor first suggests that he advance to light traffic practice, it is advisable to let this student do some country driving first and then come back to traffic and close-quarter maneuvering. This respondent also has the nervous student drive first so that he or she does not have time in the car to build up tension while awaiting his turn.

Most of the respondents reported that beginners should not be required to drive for more than 10 or 15 minutes at a time, and that each lesson should end with something the student does well and for which he can be praised.

Overcoming fear of meeting other cars — One teacher wrote of a demonstration he found effective with students who are over-concerned about meeting other cars. These students swing too far to the right in fear of being hit by an on-coming vehicle. When a vehicle is approaching, this instructor reaches over and steadies the wheel. Then he tells the student to watch thru the side window to see the amount of space between the two cars in normal passing. This is repeated until the student can gauge in advance the margin of safety in normal passing.

Summary — Most beginners are tense at first. Tension is most likely to be a problem in the early lessons when the student first puts the car in motion. Tension may recur when the student starts traffic driving after practice in a no-traffic area. The teachers who wrote on this topic agreed that a slow, confidence building procedure is necessary with most beginners. For some beginners the procedure must be paced more slowly than for others.

Teaching Driver Education to Meet the Special Problems of Students Who Are Physically Handicapped

Many physically handicapped persons can become safe drivers thru the use of special technics, precautions, and specially equipped cars. This section deals with the special problems of teaching driver education to students who have a major physical handicap.

Admitting physically handicapped students to the course — When a physically-handicapped student enrolls in driver education, one teacher schedules a conference with him at which time he explains to the student those limitations he will face in driving. The student is then sent to the state motor vehicle bureau for a "learner permit." If the application is accepted by the state officials and a permit is issued, the teacher is then relieved of the responsibility for giving the student a "yes" or "no" answer on his qualifications for driving. The teacher has found that students with handicaps try hard and learn well, and that driving often works as a kind of therapy for them.

Teaching deaf students — One respondent is a teacher of driver education in a state school for the deaf. Naturally he has found that visual materials are of utmost importance. In the classroom, traffic and parking rules are demonstrated using model cars on a mock-roadway. The opaque projector saves much time by eliminating the blackboard when problems are explained. In addition, films and filmstrips are very important resources for the teacher of deaf students.

Summary — The section on psychophysical testing discussed the problem of the student whose physical disability or low normal ability is discovered in the course of the psychophysical testing program. This section deals with handicapped students where the nature of the handicap is such that both student and teacher were aware of the disability at the outset of the course. One teacher permits any student to take the course who can meet the physical requirements for a state license. A teacher of deaf students stressed the importance of visual materials in teaching the deaf to drive.

Teaching Driver Education to the Slow Learner or Student of Low Ability

"The key to success in a program of driver education for the slow learner is the development of a course of

study which will help the student realize that each step he takes brings him closer to his goal of acquiring a driver's license.'[15]

The two teachers who wrote on this topic agreed that a very fair chance should be given to student drivers who are slow to learn. These students require more time than others in the class, particularly during the first few periods in the car. By praise and encouragement, one of the teachers tries to strengthen such a student's confidence so that he can finish the course if he stays with it.

The other teacher commented that there was too much warding off of this type of student because of the effect on the group's progress. He felt that the goal of driver education should be the same with these students as with students of normal ability.

Teaching Driver Education to Adults

The teacher of adult driver education may find that his class is full of individuals with particular driving problems and individuals whose families and friends have abandoned them as hopeless drivers.

Adult driver education courses offered by high schools have included both classroom and practice driving instruction. This differs from many commercial plans where all or most of the instruction is given in the car and where the technics of manipulating the car receive major emphasis.

Course arrangements — An adult driver education course usually differs from the regular course in the number of hours allotted, the distribution of time between classroom and practice driving, and the size of the class and the driving groups.

Teachers have found that the classroom part of the work can be covered in fewer hours, altho the same material — in condensed form — is covered with adults as with high-school students. They recommended from 15 to 20 hours for classroom work. However, the time allotted for practice driving is usually longer with adults. One respondent recommended a 10-hour minimum. Where sufficient time is not provided, the teachers frequently advised "at home" practice with a licensed driver after each lesson.

Adult classes need to be smaller than high-school classes. For classroom instruction most of the respondents mentioned a class of from 10 to 20 students, and felt that driving groups should also be smaller. One teacher did not think that the practice of having observers in the car was as profitable for adults as for younger students. Altho many of the programs do have adults drive in groups of three or four, some teachers felt that adults progress faster with individual lessons.

Practice driving teaching technics — Most of the respondents stated that the whole pace for practice driving instruction must be slower with adults. They require much more time for explanations, questions, demonstrations, and review particularly on the final practice driving lesson, which should be given in the car the adult is going to drive. One observed that his adult students are not as "daring" as his youthful drivers and that an adult may quit driving rather than face conditions for which he has had no instruction. A slow procedure for developing confidence and ability was the formula offered by another. And one observed that adults generally require much more patience and praise than his high-school students.

Instruction in cooperation with the traffic court — A plan for adult driver improvement for referrals from the traffic court was submitted by one respondent. This course offers classroom instruction only. The purposes are: (1) To aid drivers who have never had proper driving instructions; (2) To have each enrollee know himself, his physical capabilities and limitations, and to learn to compensate for his deficiencies when driving; (3) To help in rehabilitating those drivers who have failed to maintain an adequate record of safe driving performance.

This class, limited to 21 members, meets 11 or 12

[15] Kahn, Charles H. "Teaching Driver Education to Mentally Retarded Adolescents." *Exceptional Children*. Vol. 22, No. 3, p. 17-19.

times, two evenings a week for two hours each evening. Since the round table discussion method is used, text and other materials are used only as references. Course emphasis is placed on information, attitude analysis and development, and the application of material to an individual's special problems.

A difficult student — One respondent submitted a description of his work with a female adult student about 50 years of age who was very tense and had little hope of learning to drive. She had tried to learn many years ago but had given up after driving into a tree.

She was so tense that she could not shift from first to second or from second to high gear, but instead tended to shift into reverse. However, she could shift correctly when the car was not moving. Two difficulties were apparent: she was afraid to steer the car with one hand while shifting gears; and her arm was so tense that she did not realize that she was lifting up on the gear-shift lever.

First, the instructor had her steer with one hand for a few minutes. This helped. Then he had her hold a pen in her right hand at the same time she was shifting. With the pen in her hand, she could not take a "death-grip" on the lever, and hence was deterred from lifting the lever into the wrong position.

Her habit did not change immediately. On the second lesson the pen was discarded and she had no more difficulty in that respect. From then on, her learning pace, tho slow, was not excessive for a remedial case.

Summary — A qualified teacher should have no trouble adjusting from high-school level teaching to adult teaching altho problems with adults are somewhat different than with high-school students. Many of the adult students have had previous discouraging experiences with driving and lack confidence in their ability to drive. Most of the teachers who have worked in adult programs have found that the classes should be smaller, that the time allotted for classroom work can be shorter, but that the time allotted for practice driving should be longer than with high-school students. There is no experimental validation for the optimum time required for the course or the optimum distribution of time as between the practice driving and classroom phases of the course.

VIII. SUMMARY

This report has focused attention on many issues in driver education. When should the student be advanced from practice on off-street areas to practice in light traffic? How much demonstration should the teacher do in practice driving? How should students be selected for the driving groups? What type of car should be used in practice driving? How should the route be selected? These and many others are mainly issues of procedure. The goals of the course and the content of the instruction are no longer major issues. The presence of minor issues and apparent contradiction in reports from teachers working in the field are good evidence that this is a growing field.

As stated in Section I, the suggestions upon which this report is based are not offered as a "prescription" or a "package treatment" of how to teach driver education. They are suggestions from which both the new teacher and the experienced teacher may get ideas that each can adapt to his own teaching situation. Inevitably the individual teacher is responsible for the evaluation of the technics he selects for use.

When viewed collectively, the sections of this report show that, in practice, driver education has not been broken down into two unrelated phases — the classroom where attitudes and knowledge are taught, and the practice driving car where skills are taught. It is obvious from the testimony presented herein that the development of knowledge-attitudes-skills is an entity in the minds of the respondents. Thruout both phases of the course the learning process is continuous. The understandings initiated in the classroom are continued, applied, and reinforced in practice driving. Conversely, the classroom situation is frequently used to further learnings initiated or experienced in the car. Experienced teachers apparently place equal value on the classroom and practice driving phases of the course for the development of most of the attitudes, abilities, and judgments required in driving.

When the sections are viewed individually, some observations may be made which apply to secondary education in general.

From Section II on teaching the social responsibilities of driving, it is apparent that the student is being encouraged to attain standards of attitude and practice higher than those existing in the community — higher than those of his family and friends. The immediate goal of the program is to start a new driver with maximal standards of respect for law, courtesy toward other drivers, and ability to drive. The broad purpose eventually is to raise the community's standards of what constitutes sound driving.

From Section IV it may be seen that the expegrams in driver education make use of other areas of the curriculum. Therefore, these courses may serve as a laboratory for the development, modification, and validation of tests and methods of teaching. A critical need in driver education as well as in other social studies, is for instruments which validly will isolate those attitudes which will be reflected in a citizen's subsequent performance in out-of-school driving and in social and civic situations.

From Section IV it may be seen that the experiences which the teacher provides in driver education probably are closer to "real life" than those in any other course in secondary education — at least from the student's point of view. Here again is the laboratory for possible experimentation with methodology, aids, equipment, and devices; with optimum student-group arrangements for learning; and with thoro utilization of community resources.

From Section V, it seems safe to say that driver education is the most complicated area of skill-judg-

ment teaching the secondary schools have attempted. The instructor must teach the separate skills required in driving. He must also deal with two higher levels of teaching — the integration of separate skills (the coordination required in driving) and still higher, the interpretation of coordinated skills in terms of safe driving and good traffic citizenship. That he succeeds is due in part to another consideration, that of the tremendous growth which takes place when intrinsic motivation is present.

The procedure is orderly and systematic, yet flexible enough for the teacher to utilize chance happenings of unusual events in order to illustrate and further strengthen student learnings from past classroom and practice driving lessons. In teaching driving, it is particularly important that a student master the fundamental operations. Each succeeding maneuver is based on the understandings and abilities developed in all previous lessons. Each lesson is planned as the largest whole unit a student can handle. It has an internal completeness. If the unit proves too large for an individual to master, the instructor breaks it down into simpler exercises for separate practice. This means the instructor must have the ability to identify the area where the student is having difficulty, and to design (frequently on the spur of the moment) corrective exercises.

From Section VI, developing accident-free drivers, emerges an area of relatively recent exploration. A skilfull driver may not be a safe driver. Something more is required. The goal of experienced teachers is to develop drivers who are both skilfull and safe. The broader perspective of safety education adds another factor, i.e., how to drive skilfully and safely without losing the feeling of adventure. Experienced teachers see safety and adventure as compatible.

Teachers are aware that developing accident-free drivers involves much re-education, even with beginners, to establish the concept that accidents are not chance happenings, but driver and pedestrian failures. They are teaching students to recognize that "accident situations" can be avoided, and also how to respond correctly if caught in such a situation.

Section VII dealt with the problems of teaching driving to special students and special groups, experienced drivers in a class with beginners, tense students, physically handicapped students, students of low ability, and adults.

The social need for traffic safety has a broad base. All high-school youth and most adults are potential drivers. Many already are. Consequently, this "special education" branch of driver education was inevitable.

In meeting the needs of special groups teachers have demonstrated flexibility and ingenuity. Experienced drivers have been given an enriched curriculum and their potential for leadership developed. The tense student is handled with insight and imagination. Those teachers who worked with retarded students realized the importance of easily recognizable goals and the need to have those students understand that each thing that they do is a step toward the realization of those goals.

Those who teach physically handicapped youth are aware of the unique potential that is in driver education for the self-enhancement of this group. And those experienced in working with adults know that here is a way to restore a self-confidence that was almost lost. It could well be that the practices and understandings that are emerging from this segment of the broad field of traffic safety education contain its finest demonstration and greatest promise.

APPENDIX

The Questionnaire Respondents

ALABAMA

JOHN B. HALL, Dunbar High School, Bessemer
TYLER J. POSNER, Hueytown High School, Bessemer
GEORGE A. STRONG, Foley High School, Foley

ARKANSAS

N. F. BOLLING, Arkansas State Teachers College, Conway

CALIFORNIA

RALPH ACOSTA, Manual Arts High School, Los Angeles
DON ANDERS, North Hollywood High School, North Hollywood
ALEXANDER N. ATHANASOPOULOS, George Washington High School, San Francisco
OSCAR W. BAER, Hoover High School, San Diego
JACK BURGAN, North Hollywood High School, North Hollywood
DONALD CARLUCCI, Venice High School, Los Angeles
PRESCOTT E. COGSWELL, Polytechnic High School, Riverside
JOE B. CRUNK, San Fernando High School, San Fernando
STANLEY CUNDIFF, Washington High School, Los Angeles
GEORGE L. DAVIDSON, Wilson High School, Los Angeles
JOSEPH M. GALVIN, San Francisco Unified School District, San Francisco
HARRY GERDES, Point Loma High School, San Diego
CHARLES BURTON GREEN, Santa Monica City College, Santa Monica
ERNEST G. HERLITZ, Los Angeles City Schools, Los Angeles
ROBERT P. JOHNSON, San Jose State College, San Jose
MRS. MARGARET L. KING, Benjamin Franklin High School, Los Angeles
RORERT S. LEWIS, Los Angeles City Board of Education, Los Angeles
ROBERT S. LONG, Hollywood High School, Hollywood
JERRY LOVAROV, San Pedro High School, San Pedro
JAMES MCCONNAUGHY, Van Nuys High School, Van Nuys
SAM B. MARSH, Ventura Senior High School, Ventura
WALTER GRAHAM PATTERSON, Resedo High School, Los Angeles
ARMAND J. SEGETTI, Turlock Union High School, Turlock
J. SMALL, Manual Arts High School, Los Angeles
GRANVILLE E. THOMAS, Polytechnic High School, San Francisco
DOUGLAS A. WALLACE, North Hollywood High School, North Hollywood
JIM WURTZ, Avenal High School, Avenal

CONNECTICUT

ROGER A. EASTMAN, Windham Regional Technical High School, Williamantic
CHARLES D. LAWRENCE, Staples High School, Westport

DISTRICT OF COLUMBIA

THOMAS G. BENNETT, Calvin Coolidge and McKinley High Schools, Washington
JOHN D. BUTLER, Cardozo High School, Washington
WILLIAM MACKENSEN, 1509 34th Street, N. W., Washington
MILTON SARRIS, Western and Woodrow Wilson High Schools, Washington

IDAHO

HENRY E. CRUMB, Coeur d'Alene Junior High School, Coeur d'Alene

ILLINOIS

ALEX CLARK, Tonica High School, Tonica
HAROLD M. GAMBREL, Hennepin Township High School, Hennepin
WILLARD E. LASIER, Glenbard Township High School, Glen Ellyn

Normal

ROBERT J. NEUMAN, Normal Community High School, Normal
CHARLES J. RADKE, Batavia High School, Batavia

INDIANA

HARRY ANDERSON, Stoney Creek High School, Farmland
EMERY L. DRUCKAMILLER, Angola High School, Angola
RICHARD DUNN, New Salem High School, New Salem

IOWA

ROGER A. ATZ, Nevada Public Schools, Nevada
JAMES W. FREEMAN, Franklin High School, Cedar Rapids
PAUL GAMBALIANA, Hawarden High School, Hawarden
A. R. LAUER, Professor of Psychology, Driver Research Laboratory, Iowa State College, Ames
HAROLD W. SHEERER, McKinley High School, Cedar Rapids

KANSAS

GLENN A. SAUNDERS, Shawnee-Mission High School, Merriam

KENTUCKY

JOE C. HOWARD, Dupont Manual High School, Louisville

MAINE

DONALD HALE, Thornton Academy, Saco

MARYLAND

CALVIN R. ASHE, 2520 McCulloh Street, Baltimore
JOHN S. BAYLEY, Towson High School, Towson
PAUL E. BRUBECK, Patterson Park High School, Baltimore
JAMES A. QUINLAN, Howard County Senior High School, Ellicott City

MASSACHUSETTS

DANTE A. MUZZIOLI, Somerville Trade High School, Somerville

MICHIGAN

RICHARD W. BISHOP, Michigan State University, East Lansing
LELAND MONK, Quincy Community School, Quincy
CARSON NICFERT, Dowagiac High School, Dowagiac
ELMER A. REWALT, Allegan High School, Allegan
ARTHUR D. SQUIRE, W. S. High School, Kalamazoo
THEODORE TACK, Decatur High School, Decatur
J. I. WALDON, Emanuel Missionary College, Berrien Springs

MINNESOTA

CLEVE BERQUIST, Mora Public School, Mora
BOB HARY, St. Cloud Public Schools, St. Cloud
MILLARD C. OLSON, Independent School District No. 7, Cloquet
LEO JOSEPH WINKLER, Martin Hughes High School. Buhl

MISSOURI

EMMETT BROWN, Paris High School, Paris
EVERETT W. BROWN, Northwest Missouri State College, Maryville
HAROLD L. RILEY, Smithville High School, Smithville

NEW HAMPSHIRE

CHARLES CHAMBERLAIN, Canant High School, East Jaffrey
ARTHUR K. DAY, Portsmouth Senior High School, Portsmouth
ELTON B. SMITH, Hampton High School, Hampton

NEW JERSEY

JOHN E. CALLERY, William MacFarland High School, Bordentown
N. A. HANSEN, New Jersey School for the Deaf, West Trenton
IRA SCOTT JOHNSON, JR., Ocean City High School, Ocean City
WALTER N. MARUSYN, Wayne High School, Belleville
MARTIN SHAW, Middletown Township High School, Leonardo
GEORGE TRAUB, Pitman High School, Pitman
RUSSELL E. WRIGHT, Lakewood High School, Lakewood

NEW MEXICO

HENRY G. SANCHEZ, Belen High School, Belen
ALAN R. THOMPSON, Quay County Rural System, Tucumcari

NEW YORK

WILLIAM S. ASHLEY, Freeport High School, Freeport

WILLIAM J. DALY, Whitehall High School, Whitehall
VINCENT J. A. DAVIES, Mynderse Academy, Seneca Falls
RICHARD D. ELLIS, Whitesboro Central School, Whitesboro
JAMES F. FAHNESTOCK, Sandy Creek Central School, Sandy Creek
EARL D. HEATH, Center for Safety Education, New York University, New York
EARL K. JAMES, Rochester Institute of Technology, Rochester
IVAN A. MCDONALD, Red Hook Central School, Red Hook
FRANCIS J. MANLEY, Woodlawn High School, Woodlawn
RICHARD J. PEPPER, Tully Central School, Tully
CHARLES ROONEY, Roslyn High School, Roslyn
KENNETH T. SAWERS, Center for Safety Education, New York University, New York

OHIO

CLEO L. BARD, Liberty Center Schools, Liberty Center
BOOKER T. BROWN, JR., Central State College, Wilberforce
WESLEY CARR, Tallmadge High School, Tallmadge
RUSSELL COFFEY, State University, Bowling Green
WILLIAM Z. DAVIS, McKinley High School, Niles
CARL DOEBLER, Toledo Public Schools, Toledo
J. C. EDWARDS, Convoy-Union High School, Convoy
WYLIE T. GRAHAM, Fairmont High School, Dayton
ROBERT HALL, Kent State University High School, Kent
TED N. HUMMEL, Lorain High School, Lorain
ADOLPH MADARAS, R. F. D. No. 1, Pemberville
JESS MEYERS, Lanier High School, Defiance
PAUL L. MILES, Toledo Public Schools, Toledo
DON E. PERRY, Ohio University, Athens
HARRY G. SEITZ, James Ford Rhodes High School, Cleveland
HUBERT E. WHITE, Woodrow Wilson High School, Youngstown

OKLAHOMA

JACK N. GREEN, Southeastern State College, Durant
C. C. HOLCOMB, Lone Wolf High School, Lone Wolf
RAYMOND L. SCHOFIELD, Covington High School, Covington

PENNSYLVANIA

JOHN A. BRACE, Swissvale High School, Swissvale
ROBERT V. BROWN, Haverford Township Senior High School, Havertown
MARIO J. CREANY, Nanty-Glo High School, Nanty-Glo
CLOYD O. DERICKSON, Williamsport Technical Institute, Williamsport
LLOYD M. DOUGLAS, William Penn Senior High School, York
HERBERT E. ELIAS, Butler High School, Butler
GRIER T. GILLILAND, Bellevue High School, Pittsburgh
HARRY HARLACHER, JR., Palmyra High School, Palmyra
DONALD B. HERMAN, Amity Township Consolidated High School, Amity
ALTON A. HUNTLEY, Greensburg High School, Greensburg
JAMES E. MCCALL, Philipsburg Joint Area High School, Philipsburg
ANTHONY D. MAZZOCCO, Baldwin High School, Pittsburgh
LARRY J. MUSSOLINE, Hazleton Senior High School, Hazleton
HAROLD V. WELSH, Lock Haven Senior High School, Lock Haven
GEORGE H. WOERNER, John Bartram High School, Philadelphia
D. WILLARD ZAHN, Dean, School of Education, Temple University, Philadelphia

SOUTH DAKOTA

MARVIN L. JONES, Central High School, Aberdeen
ARTHUR J. MATSON, Lake Preston Public Schools, Lake Preston
DONALD E. YOUNG, Black Hills Teachers College, Spearfish

TENNESSEE

SOLON B. SUDDUTH, Head, Department of Physical Education, George Peabody College for Teachers, Nashville
BENJAMIN C. TINNELL, East Tennessee State College, Johnson City

TEXAS

CARL RICHARD BURTON, San Antonio Public Schools, San Antonio
LARRY CUNNINGHAM, Hardin-Simmons University, Abilene

JAMES O. FRANKLIN, Highland Park Public Schools, Dallas

C. T. HOWELL, Amarillo High School, Amarillo

RAYMOND KIREILIS, Texas Technological College, Lubbock

FARLEY VINCENT LEWIS, Wichita Falls Public Schools, Wichita Falls

L. H. MATHEWS, Nacogdoches

RUFUS K. WOMBERLY, Ozona High School, Ozona

VIRGINIA

REBECCA BROCKENBRAUGH, Longwood College, Farmville

CHARLES P. CURCIO, Virginia High School, Bristol

ELEANOR WEDDLE, Longwood College, Farmville

WASHINGTON

LOUIS W. GAISER, Jenkins Senior High School, Chewelah

WISCONSIN

ELDON K. BORN, North High School, Sheboygan

HARVEY L. HANSON, Chippewa Falls High School, Chippewa Falls

CLYDE M. KNOX, Reedsville High School, Reedsville

F. C. LAUN, Rufus King High School, Milwaukee

DAN E. SCHUCK, Menomonee Falls High School, Menomonee Falls

WYOMING

DOYLE DUDNEY, Niobrara County High School, Lusk

F. A. HOLMES, University of Wyoming, Laramie

1-58—5M

Mr. Abercrombie. Researches in progress are an evaluation of tests in driver education and the preparation of a teacher's test guide; a critical analysis of research findings which indicate the extent and value of the transfer of training which may result from the use of simulators in driver education; and a directory of offerings by colleges and universities in highway safety and highway traffic, based on a nationwide survey conducted jointly by the United States Office of Education and the NEA national commission on safety education.

Now, turning to what needs doing in traffic-safety education research, it may be categorically stated that very few of these research needs will be met unless substantial funds become available.

In the study on research needs in traffic-safety education, nearly 1,000 teachers ranged 36 experimental research topics and 28 survey research topics in terms of what they felt would be the potential usefulness of the findings in the teaching situation. Areas of experimental research judged most valuable were those which dealt in some way with (1) identifying, (2) measuring and testing, and (3) instructing to correct the personal characteristics, or skills and attitudes, of drivers.

The highest-ranking survey research studies had to do with (1) overall evaluations of driver education, (2) effective teaching methods to develop attitudes and skills, (3) identifying persons associated with accidents, (4) digesting research to make effective content and instructional materials for traffic-safety education, and (5) identifying the types of traffic accidents involving children and youth.

In the recent public officials' traffic-safety conference and the more recent Williamsburg conference on traffic-behavior research, both held under the auspices of the President's Committee for Traffic Safety, some of the research ideas generated that would be valuable for education may be expressed in such questions as: What do we need to know about driver attitudes and basic personality structures as related to risk-taking behavior? What measures of traffic safety can be suggested that would be more valid and reliable than the ones now in use? How can traffic-safety education be effectively incorporated in the elementary-school curriculum? In what ways can communication among drivers be increased so as to reduce driver anonymity in traffic? How may teaching procedures in driver education be improved? Through what methods can we assure a greater degree of carryover from traffic-safety instruction to daily living? Can the experienced driver's accident potential be reduced through refresher courses? To what extent should student drivers receive instruction and practice in meeting emergency driving situations?

Many problems in traffic-safety education will be solved only through basic research. These problems should be studied thoroughly by qualified researchers or by competent research teams. But other problems must and can be worked on by individual teachers with their own students in the typical school situation. Whether these teachers receive advanced degrees for their research is somewhat beside the point. A sizable need exists for developing a solid body of tested practices that will enhance the teaching of traffic safety and driver education. This need can be met only if many hundreds of teachers experiment, observe, and report, over and over again, in a continuing endeavor to find better ways of teaching.

Even if substantial funds become available to support greatly increased educational research in traffic safety, the doing of the research itself will be of little value unless machinery is set up to assure widespread application of the research findings. In other words, of what use will better answers be if we don't conscientiously plan to put these to work?

If and when we greatly expand our research effort, we should not forget the equally important tasks of helping people learn about the research findings and, also, of actively assisting them in putting the findings into practice.

Needed are (*a*) a reviewing and interpreting service on a scale not yet dreamed of; (*b*) programs for actually demonstrating the findings of studies and for motivating teachers to begin using them; and (*c*) arrangements to asure that research results find their way into the many text and reference materials used in teaching and learning.

Money to support a series of research-oriented conferences and workshops for teaching personnel, staffed by qualified educators who know their way around in research, would be a boon to getting traffic safety education research off the ground.

Thank you.

Dr. McFarland. Thank you very much.

Mr. Chairman, I think one of the basic needs for research in this field is to try to set up well-controlled studies to evaluate the effectiveness of driver training where one has matched groups with and without training on a large scale.

We have some evidence in this area, but it could be supplemented to the great advantage of those who are planning such programs. There are approximately 20,000 high schools in this country, and only about half of them, or 10,000, do something in the way of driver training. It would, obviously, be of great importance to set up broad-scale programs in this area, but it would be very advantageous to have more concrete data to substantiate and to actually plan these educational and training programs.

I am sure Mr. Abercrombie would agree with this general statement.

I am next going to call on Mr. William Johnson, who is the general manager of the National Safety Council.

Mr. Chairman, as you can realize, this is no average job. Mr. Johnson has, I think, a $4 million budget in a very important field. The country has depended upon the National Safety Council for information in this field for many years. I think it is high time that the universities and other research agencies try to support the very effective work of the National Safety Council.

Mr. Johnson.

STATEMENT OF WILLIAM G. JOHNSON, GENERAL MANAGER, NATIONAL SAFETY COUNCIL, CHICAGO, ILL.

Mr. Johnson. Thank you, sir.

Mr. Chairman and members of the committee, the following statement is made on behalf of the National Safety Council. I will omit the portions of the statement that overlap the testimony of some of the other members of the panel.

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What is the need for research? In joint testimony of the National Safety Council, American Bar Association, and Northwestern University before this committee in March 1957, the three agencies presented the "time for decision" chart of services of national traffic safety agencies. These services, one of which is research, were related to the objectives which make up the national traffic safety program. The chart indicated that research was "adequate" for only 1 of 14 objectives; "barely adequate now and inadequate for future needs" for 5 objectives; "inadequate" for 8 objectives.

The traffic and transportation conference of the council is reviewing the judgments expressed in that chart to make them representative of all national traffic safety agencies. Revisions agreed upon thus far describe research status as follows: "Barely adequate now, inadequate for future needs," 4 objectives of traffic programs; "inadequate for present needs," 10 objectives; "adequate," no objective has adequate research.

A copy of the revised chart will be submitted for committee records when the conference has completed its work.

The typical traffic accident is a complex incident with numerous indicated variables involving almost all aspects of man and his environment. There is evidence that successful safety work in one field bears additional fruit in other fields of activity of the particular population involved. In consequence, the National Safety Council believes that it is necessary that safety research concern itself in some degree with all accidents and with all aspects of man and his environment which are likely to be important factors in the cause and prevention of accidents.

Since the family and citizen groups—church, employment, association, labor union, clubs, et cetera—offer promising avenues to influence behavior, research should be broad enough to encompass the full range of accident prevention interests of those groups. While interest at a given time, such as today, is focused on a specific problem, longer range observations indicate common attitudes and approaches to various accident problems are significant. The family interest in overall safety measures may well prove to be the key to various specific problems of behavior.

What is the economic justification for research?

Research investments are justified when we consider the following facts:

1. The costs of accidents in 1957 were estimated at $11,800 million, of which $5,300 million was traffic.

Those figures may be low in light of the recent figures of the health survey.

2. The cost of traffic congestions probably exceeds the cost of traffic accidents.

3. Accidents and congestion blight municipalities and limit the use of vehicles, with consequent limitations on economic growth.

4. Costs of accidents are held to the above levels only because of a multibillion dollar effort—and more accident prevention expense is demanded every day. Research can increase the "per dollar" result of preventive effort, and research expenditures must be budgeted in relation to the many billions of dollars now spent or wasted.

What is the National Safety Council's role?

The National Safety Council has only a limited role in the area of research. The major function of the council is to serve as a meeting place for all organizations concerned with the prevention of accidents. In a sense it is an association of "users of research."

We have two special projects. I will touch on one of them.

The National Safety Council, with the assistance of the Automotive Safety Foundation and the Computer Laboratory of New York University, is conducting a special study of 180 cities to determine the relationship between motor-vehicle-fatality rate and 32 elements of the standard traffic-safety program reported in the Annual Inventory of Traffic Safety Activities. Those elements are such things as the number of convictions, and so forth.

This study, if meaningful relations are found, may be a major scientific breakthrough in accident prevention.

What is the role of the Federal Government?

In joint testimony of the National Safety Council, the American Bar Association, and Northwestern University before this committee in March 1957, the three agencies said—and if the chairman will permit, I would like to repeat that for the benefit of the members of the panel:

> Presently we have virtually no research in the field of street and highway traffic-accident prevention, with the exception of highway research and vehicle research. And we have weak application of what we do know for the simple reason that the national program being carried on by the national traffic-safety agencies of this country is inadequate and uncoordinated.
>
> We must have coordination between safety groups. If we lay the base for really sound coordination through adequate research and developmental programs, particularly on administration, then we shall get as a result operational coordination between the national traffic-safety agencies. We will not have coordination of these national safety programs until research provides more basic answers, both technical and administrative.
>
> The proper role of the Federal Government does not lie in traffic control and regulation, functions assigned to State and local government in our present governmental system. Federal regulation of traffic would not only be expensive and ineffective, it would also impair State and local government itself and would, therefore, weaken our democratic system. The Federal Government can make its most concrete and resultful contribution through the support of research and developmental work which is critically needed.
>
> There are many research groups competent to carry out the research required, but they presently have no funds.
>
> If support is not coming from the Federal Government, there are no realistic alternatives, and this research and developmental work will consequently not be done. And the work of safety agencies will continue to be inadequate.
>
> If, on the other hand, the Federal Government can participate, it will strengthen the work of these national traffic-safety agencies and materially help coordination.
>
> If we fail to strengthen the national traffic-safety agencies, to make better application of what we now know, to get better answers through research and development, we shall continue to fail as in fact we are now failing to deal adequately with this problem. The tendency inevitably will be pressure of public demand for the Federal Government to directly intervene and to become an operating agency in this field. This would, we think, be an unhappy day for the Government of the United States and for its people.

Dr. McFARLAND. Thank you very much.

We now will turn to a series of men whose interests are directed more toward the engineering side of the problem having human implications.

The first person I am going to call on is Dr. Ted Wright, who is vice president for research at Cornell University at Ithaca.

Dr. Wright, as you may know, has had a long and distinguished career in industry, in Government agencies, in aeronautical fields, and now as the Director of Research at Cornell University.

It is a great pleasure to call on him.

STATEMENT OF DR. THEODORE P. WRIGHT, VICE PRESIDENT FOR RESEARCH, CORNELL UNIVERSITY CENTER FOR HIGHWAY SAFETY RESEARCH, ITHACA, N. Y.

Dr. WRIGHT. Dr. McFarland, Mr. Roberts, and ladies and gentlemen: As Dr. McFarland mentioned, my interest in safety stems from the time when I was Administrator of Civil Aeronautics and was exclusively in the aeronautics field.

Subsequently, since I went to Cornell we have branched into both aeronautics and automobile. I am going to brief this discussion to a mere statement of seven points for which elaboration will have to be found in my printed statement.

First, I am going to recall to your mind that the tremendous advances in science and technology which we are now experiencing are due entirely to the introduction of a method, some 300 years ago, which as the scientific method, basically states that we must proceed from facts to conclusions. Conclusions may be postulated but unless they are backed by facts and constantly and continuously checked against facts as they come to light, they are rather meaningless.

Second, how does this apply to highway safety? I think here as in any other science or technology we must base conclusions on facts and this, if I may use my own organization as an example, we are doing by establishing field teams in 16 or 17 areas of the United States representing all types of traffic from which we obtain information from police officers and medical men in the hospitals where victims are taken in order to report facts on every particular accident that we can lay our hands on in this area.

These, then, go to a central office for analysis, are put on IBM cards and machines sort them so that an analysis under any particular criterion can be made.

We have dealt quite extensively with the causes of injury in the past and are now getting fully into the field of causes of accidents.

Third, for any kind of conclusion to be valid the facts must be on a wide base. They must not be a few facts only but on a sufficiently wide coverage so that statistically one may properly draw conclusions.

Fourth, a university appears to be a good type of agency for dealing with the complexity that many speakers before me have mentioned on the problems which deal with three elements, the man, the machine, and the medium.

Thus, you have medical factors and human factors in the man; design factors in the machine; and the road and its environment in the medium.

This group of which I spoke (CIR Auto) now has an accumulation of some 20,000 actual reports on accidents throughout the country and is obtaining statistical information at about the rate of 10,000 a year.

Fifth, a university has many disciplines; in fact, almost all disciplines within its organization. In the field of man: Psychology, sociology, law, medicine, surgery, physiology, and biostatistics.

In the field of the machine, it has mechanical engineers, design engineers, and other branches of engineering.

In the medium, that is the road and its environment, it has civil engineering and electrical engineering which impinge on these problems.

Really what we are talking about is operations research, a term that sprang up in the Second World War and was used so effectively in solving problems of multiple complexity. It is only by the impingement of scientists from a great many disciplines on any complex problem that you can get a type of answer on which you can really rely.

This deals both with basic research, which is simply the analysis of facts to see where they may lead, followed by applied research which predetermines aims and in which you apply the statistics that you may gather.

Both are essential, particularly basic research.

Sixth, this is our experience of 7 years' duration in the automotive field and 9 years previous to that in the aeronautics field where we have established the techniques of getting facts and the techniques of analyzing them.

Finally, as to financial needs, I think we can say that this is a big problem and it is going to cost a lot of money. We are getting very generous support now as are other organizations, universities, and others, from certain branches of the Government and from certain elements in the automobile industry as well as others.

This effort is just one university, and you have many others represented here, is now about a six-hundred-thousand-dollar-a-year proposition. We expect within the next year to go up to about a nine-hundred-thousand-dollar-a-year expense so that you can roughly say that we are looking toward a million-dollar operation, and when you multiply that by the cost of the efforts of other people who are doing very effective work in the field of research in automobile safety, you can see that these are not small figures.

I, therefore, feel that it is appropriate for the Federal Government more extensively to back research, along with the industry and with other agencies, in order that we can meet the challenge which is ahead of us.

I thank you.

(The statement follows:)

TESTIMONY OF T. P. WRIGHT

Mr. Roberts and members of the Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, may I first, as a university man,[1] recall to your attention the basic reasons for the tremendous advances in science and technology which have been witnessed in the past 300 years and more especially, in the past 25. This surge of advance which moves ahead by geometric progression, has been brought about by the application of inductive reasoning in science; that is, preceding from fact to hypothesis and always rechecking what are apparently established hypotheses when new facts come to light. This is the scientific method—fact to conclusion.

I feel that this same method must be applied in any study of highway safety. Thus, recurring facts which seem to fall into a pattern when making broad investigations of highway accidents suggest possible improvements in the automobile or in other relevant areas such as the driver or the highway, or combinations of all of these. Although it is appropriate to hypothesize potential

[1] See appendix A.

improvements, they cannot be considered valid until proof from actual study of facts in accident investigations are at hand and anlayzed.

A few facts may be a dangerous thing. It is only by accumulating facts on a wide base and from many cases that valid conclusions can be reached. It is for that reason that the crash injury research project under Mr. Moore has expanded its area of coverage until at the present time it includes some 16 States representative of all types of traffic which occur in the United States.

Once facts are accumulated, the analysis function becomes all-important. Conclusions can then be drawn, always subject to continuing check as new facts come to light. Thus, any program which is organized to deal with the overall problem of traffic safety must be a continuing one.

It is the contention of our highway safety center that traffic safety improvement must involve correlated studies of the man, the machine, and the medium; thus making it possible to investigate medical and other human factors, automobile safety design, and road safety design together with highway environmental conditions. At the heart of this overall program is the automotive crash injury research project which engages in its very large highway accident field studies program and then produces analytical and interpretative reports in many areas of coverage.

Facts accumulated by the CIR (automotive) program are now sufficient so that valid conclusions can be reached. These facts, obtained over such a wide base, give reliability to the conclusions reached. There are, at the present time, case histories of some 20,000 accidents in the United States, most of which have been analyzed but many of which are still in the progress of analysis. The rate of accumulation of cases is now of the order of 10,000 per year.

With this base of facts within its structure, a university is an ideal organization on which to prepare studies and arrive at conclusions since these can be of a cross-disciplinary character. Thus, we have within our structure such apparently unrelated disciplines as psychology, sociology, law, medicine, surgery, physiology, and biostatistics all applying to the man; mechanical engineering, design engineering and other engineering disciplines applying to the machine; and civil engineering, electrical engineering, and others pertaining to the medium, that is, the highway and its environment. The approach may therefore be somewhat along the lines of operations research, a technique developed during the war with such great effectiveness. The university, I contend, is a uniquely appropriate place in which to conduct study of highway safety.

Although my own university has a long experience in this field, inasmuch as the crash injury research project is now some 7 years old, I do not wish to imply from this that the work of other universities or, indeed, other organizations, is anything but desirable. The efforts of others of which we are aware are indeed complementary to the work of Cornell. They involve such things as technique, methodology, special phases of investigation, and investigations in special localities. The particular competence of Cornell University and the crash injury research program is the already established technique and organization for collection of field statistics on a comprehensive base and the application of modern techniques to the analysis of case studies. The work is conducted on IBM machines, and I should mention that, in addition to the present equipment, there is established at the Cornell aeronautical laboratory a large IBM 704 computer, applications of which to our program are now under consideration.

The expanded program which we propose may be subdivided between basic research; that is, accumulation and analysis of facts of overall application; and applied research, where more specific subjects which are brought to our attention are investigated by recourse to our cards of cases. Altogether we have well over 100 studies which we believe should and can be conducted. Regarding our methods of procedure and the analytical results therefrom, attention is called to the references appearing at the end of this report.

A program so comprehensive as ours requires a considerable amount of money in the form of research grants. It is obvious that having field study personnel in the 16 or 17 areas is a rather expensive job. In addition, the analysis of the facts which are constantly pouring into our New York headquarters is also expensive. However, when I state that the costs in this whole program at Cornell is of the magnitude of $600,000 a year (and is projected to $900,000), I wish also to emphasize that this is really insignificant in comparison to the costs which the Nation is suffering annually in terms of lost lives, of serious injuries, and property damage. It is our conviction that this type of study can and will result in very substantial reductions in the rates of lost lives and injured property.

My colleagues who are also testifying at this hearing will give you many instances which justify statements such as the above.

It has indeed been an honor and a pleasure to appear before your committee which is giving such careful consideration to this serious problem of epidemic proportions which confronts us today—the problem of achieving a better record in highway safety.

APPENDIX A

The capacities in which I appear before you are submitted in justification for my testifying in this all-important field of traffic safety. I am vice president for research of Cornell University and president of the Cornell aeronautical laboratory, where a very substantial amount of work has been conducted in the field of automobile design for safety. In addition, I am chairman of the governing board of the Cornell University center for highway safety research, within which organization is the crash injury research (automotive) project headed by Mr. John O. Moore and closely associated with the Cornell University Medical College. I might add that I was formerly Administrator of Civil Aeronautics, and from that time (1944–48), my interest in vehicle safety has remained undiminished.

The opinions I express in this testimony are my own but do, I believe, represent the concerted beliefs of the several organizations with which I serve.

APPENDIX B. REFERENCES

1. Progress report, automotive crash injury research, period October 1955 through March 1957.

2. Report of John O. Moore, director, automotive crash injury research, Cornell University Medical College, presented in September 1957 at a meeting of the sixth district of the Medical Society of the State of New York. Title, "A Method To Identify and Control Causes of Injury and Death in Automobile Accidents."

3. Testimony of John O. Moore, director, crash injury research program, Cornell University, on August 8, 1957, before the Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce. Title, "Seat Belt Hearings in the United States House of Representatives."

4. Reports prepared by the Cornell Aeronautical Laboratory:

(*a*) Automobile Seat Belts—A Way of Life, prepared by Edward R. Dye and Alvin C. Smith.

(*b*) Human Packaging Problem, article appearing in publication Research Trends, volume II, No. 2, summer 1954, written by Alvin C. Smith.

Dr. MCFARLAND. Next we are going to call on Mr. Milliken, of the Cornell Aeronautical Laboratory, to give a statement.

Mr. Milliken.

STATEMENT OF WILLIAM F. MILLIKEN, JR., CORNELL AERONAUTICAL LABORATORY, BUFFALO, N. Y.

Mr. MILLIKEN. Mr. Chairman, committee members, I would like to amplify Dr. Wright's remarks briefly.

Speaking from our laboratory viewpoint, we feel that an ultimate engineering objective would be the ability to predict the dynamic performance of a traffic system.

Essentially this means the creation of a mathematical model which we could put onto a computer and which would be useful in the rational design of automobiles and highways, and would be useful also in the determination of desirable driver qualities.

We feel that such an operational analysis is by no means beyond the realm of present scientific technique. Such an analysis would recognize, first, all the important factors; second, would mathematically evaluate these factors for computing or computational procedure, and finally study all of these factors as a unit.

Some of the data which would be required for such an analysis will certainly be available from the AASHO road test.

Some of the work which we have been doing for General Motors would be useful also in conjunction with the dynamics of the automobile. However, we concur with the other speakers that the data on the driver in his environment is very small at the present time and it is extremely difficult to obtain this information on the highway because one cannot go out there and introduce accident situations.

A device which would certainly go a long way in obtaining the type of information which we need upon the driver would be a driving simulator, a device which would reside within the laboratory and yet simulate the process of driving to a sufficient degree of reality that the driver would "lose" himself in the machine, believing that he was actually driving a car.

One of the technical blocks to the design of such a simulator is the simulation of the visual scene. This is the only item, I believe, which has held up the creation of a driving simulator for so many years.

Recently the United States Public Health Service has initiated a study on feasibility of a driving simulator and there is reason to believe that this block (of the realistic presentation of the visual scene) can be overcome.

If we had such a simulator we could obtain first-off psychophysiological data in particular situations on drivers.

Second, and I believe this is even more significant, we could obtain data which would lead us to mathematical models or mathematical expressions of the human driver in these control situations; in other words, in highway situations.

Recent work, largely sponsored by the Air Force, in an effort to mathematically represent the human being appears to be extremely promising. We have, for the first time in connection with certain aeronautical studies, been able to come up with a simple equation (which could be placed on a computer) which represents the fashion in which the man operates a particular machine, the airplane. We have in turn been able to run what we call a closed loop analysis comprising the environment, the human and the machine.

We appreciate, of course, that a driving simulator which is comparable to one of these Air Force simulators or Air Force trainers is an expensive device and would probably run into several millions of dollars.

On the other hand, I think that one must view such a device as constituting the major breakthrough which is needed to really get to the bottom of this highway safety problem.

Dr. McFarland. This, it seems to me, is extremely important. We have all been waiting for the engineers to put their minds on the integration of the driver with his equipment and many of us believe that this can be done in a quantitative way and until we get such quantitative data, it is almost impossible to know what should be done about certain aspects of design equipment and highways and certainly how to gain greater control over the driver. Instrumenting the driver with modern electronic devices, in our opinion, offers great promise and there are a number of groups that have now started on this line of research. It is very costly and we need help.

We have started such a project at Harvard, as you know, in close collaboration with Mr. Milliken and his group.

(The statement follows:)

STATEMENT OF WILLIAM F. MILLIKEN, JR., EXECUTIVE VICE PRESIDENT AND DIRECTOR, CORNELL AERONAUTICAL LABORATORY, INC., BUFFALO, N. Y.

The present statement is generally representative of the views of the Cornell Aeronautical Laboratory and more generally of the Cornell family. Specific opinions of the author stem from his experience in physical research.

Careful surveys and comparisons serve to indicate that the field of traffic safety has yet to be attacked upon a broad and basic scientific front utilizing all available, and in many instances recently developed, experimental and analytical methods and techniques. The rational implementation of such an approach should stem from what is currently termed a "systems outlook." Thus, the total highway system is composed of such major elements as the road, the automobile, the driver, and his total environment, all of which must be studied sesparately and in concert. In the aggregate, the overall highway system is a dynamic entity, the behavior and performance of which depends upon all elements involved and their interactions.

In the past, single actions, such as regulations, safety devices, highway design details, etc., have been studied with little awareness for the system as a whole. The knowledge thus accumulated is by no means lost but needs substantial reinforcement in many cases, and a broader viewpoint upon its relative significance. Important research on two major components of the overall system is currently underway; namely, that of the highway design itself and the automobile. The AASHO road test project will yield data which, if analyzed according to present plans, will be invaluable for an overall systems analysis. In recent years, a fundamental approach to the dynamics of the automobile has been undertaken by our own laboratory with the sponsorship of General Motors, and this is leading to a fundamental understanding of the automobile component. Much work on the automobile and its tires remains to be done, but at least the proper level of scientific technique has been brought to bear.

Fundamental research upon the driver and his environmental component is conspicuously absent. It is true, of course, that certain psychophysiological studies have and are being made that relate to the driving problem, but all of these studies have beeen sharply limited by the impracticality of studying the driver in actual highway operational situations, particularly those involving accidents, or in studying the driver in controlled scientific experiments. In addition, an extremely powerful tool for the study of the dynamics of human behavior, as recently developed in aeronautical circles, has not as yet been applied to the driving case. This technique, which promises a mathematical expression of driver performance in control situations, will ultimately permit the examination of total system performance on computing equipment. Thus no great fundamental advance can be anticipated until quantitative, as well as qualitative, means are available for specifying the driver and then the system.

Progress is then essentially blocked at the present for lack of knowledge of the driver and this, in turn, stems from our inability to accomplish appropriate scientific research on the highway. A driving simulator, a device which would permit the accurate simulation of the driving situation in the laboratory, would be of immense value. The simulator concept in this connection is not new but has presented insurmountable technological obstacles to its development and, in particular, to the faithful representation of the total environmental inputs to the driver, or still more specifically, an accurate representation of the visual scene including its dynamic relationship to the actions of the driver. The Division of Special Health Services, under the Department of Health, Education, and Welfare of the United States Health Service, has recently proposed a reexamination of the problems of the design of a driving simulator, and the Cornell Aeronautical Laboratory has been chosen for the performance of this task.

In the initial studies leading to this contract award, this laboratory has suggested means of simulating the visual scene which appear extremely promising. Final evaluation awaits additional study, but it now seems quite evident that the possiblities of constructing a driving simulator are excellent.

The development of a driving simulator will represent a task comparable to that of the development of other types of simulator equipment, such as used by the Air Force for training and research.

As with other fundamental research, an attack upon the driver component will have important payoffs in other directions. A quantitative understanding

of human dynamic behavior has almost limitless application in connection with the manual control of all categories of machines, military weapons, etc. The development of a suitable visual presentation offers immediate application to a variety of military simulators for aircraft carrier operation. VTOL/STOL aircraft, tanks, etc.

In conclusion, important advances in highway safety are contingent upon the broad application of the best tools that physical and behavioral sciences have to offer, on a systems concept basis. No real progress can be made until the driver behavior is understood, and the loop is closed for study.

Dr. McFarland. I am next going to call on Mr. John Moore to make a statement of his opinion in regard to research in this field.

All of us followed with great interest the work that John has been doing in the Cornell automotive crash injury research.

The only thing that I feel about it is that it should be done on a national scale instead of only in 12 States.

I am very fond of John, and I hate to put such a job upon him, Mr. Roberts. It would certainly be important if this could be expanded on an even broader scale than at present.

STATEMENT OF JOHN O. MOORE, DIRECTOR, AUTOMOTIVE CRASH INJURY RESEARCH, DEPARTMENT OF PUBLIC HEALTH AND PREVENTIVE MEDICINE, CORNELL UNIVERSITY MEDICAL COLLEGE, NEW YORK, N. Y.

Mr. Moore. Dr. McFarland, Mr. Roberts, and members of the committee and fellow panelists, I will attempt to very briefly digest my remarks which I hope to offer to the committee for its record in an extended form.

I think the thing in common about all of us today is that we have pointed out that our primary concern for being here is to express the need for a scientific, integrated, and preplanned, research attack on traffic safety problems.

In general, the research efforts of all of us are directed toward one of these three segments of the problem:

First, we attempt to find methods for selection and control of individuals best suited to drive, rejection of those unsuited, and training of those individuals who need better skills;

Secondly, we are working on research into methods for the improvement of highways, vehicles, and traffic supervisions; and

Third, we are working on scientific methods for the controlled reduction of injury and death associated with motor vehicle accidents.

Each of us pursues his segmental approach, often with an inner conviction that solutions we may find in our own approach will have greater effect on the traffic safety problem than any other. This cannot be accepted as truth. No simple, single solution will suffice to solve one of man's most complex and important problems—increased mobility.

It is my opinion that this shortsighted approach is attributable to some extent to our inability to maintain long-range plans because of the usual short-term financial provisions for these research projects. Often when a project is just nearing its most fruitful point, its principal investigators or key personnel are diverted from the task of research to the task of solicitation of funds.

I believe that Federal agencies or large philanthropic organizations are best suited to solve this peculiar need of research, long-range funds.

I believe that the three basic concepts or objectives of traffic safety outlined above are inseparably interlocked, in the sense that none affords the full solution and all must be obtained if the fundamental problem is to be solved.

In my opinion, the aims of all of us present could be immeasurably advanced if we were able to subscribe to the following conditions:

1. Establishment of some form of central agency or agencies charged with the responsibilities of providing uniform scientific standards of data collection, data identification, and data interpretation, and serving as both a communications clearinghouse and a coordinating nucleus for all activities in the field of traffic safety research.

2. Formation of a National Advisory Committee on Highway Safety Research, with authority to review and evaluate individual project proposals, and to assign to them recommended priorities for long-term grants, on the basis, first, of their potential for contribution as scientific tools to subsequent research and, second, their potential to produce findings directly applicable to the measurable reduction of traffic accidents, injury, and death.

At first glance, the cost of maintaining such an agency seems prohibitive. However, we have from Dr. Wright's remarks evidence that universities at present already have available, within their organized training program, the multiple disciplines needed.

Our own program is now collecting data out of preplanned sampling areas in some 16 States, with a 17th State soon to be added.

We are able to bring to bear on part of this problem factual data, which can be used for interpretation and analysis not only in our agency but in others.

The bulk of our data at present deals primarily with associations between man and the vehicle and their relationships to his subsequent injury or death. This data gathering or scientific approach, which investigates rather than reports, could be applied to establish facts regarding the causal relationships between man, machine, and the environment in which man and the machine operate.

The present lack of proper perspective in the field of traffic safety is such that, it may be said of many of us with some justification, we at times cannot see the forest for looking at the trees. Since it is possible that our program is no exception, we can ask no more than that our own particular needs for long-range funds to continue our work be evaluated within the context of the total traffic safety problem.

Thank you very much.

Dr. McFarland. I think all of us who know John realize that he has been living what he has been preaching. I do not know of anyone who has put his life into this field more than he has.

(The complete statement follows:)

TESTIMONY PRESENTED BY AUTOMOTIVE CRASH INJURY RESEARCH

(Introduced by John O. Moore, director, automotive crash injury research, Department of Public Health and Preventive Medicine, Cornell University Medical College, New York, N. Y.)

Dr. McFarland, honorable members of the subcommittee, respected colleagues, we at ACIR believe that we should be remiss in our obligations if we failed to state our opinion that the particular needs of none of us as individual researchers here today should be considered except as matters of secondary importance. To do so is to risk the perpetuation of those very inadequacies which have

prompted the subcommittee to summon us here for a discussion of traffic safety research needs. Our primary concern should be for an integrated, preplanned, and scientific research attack on traffic safety problems.

1. In general, the research efforts of all of us are directed toward one of these three segments of the problem:

(*a*) Methods for the selection and control of individuals best suited to drive, and the rejection of those who are unsuited to do so.

(*b*) Methods for the improvement of highways, vehicles, and traffic supervision.

(*c*) Methods for the controlled reduction of injury and death associated with motor-vehicle accidents.

Each of us pursues his segmental approach, often with an inner conviction, that solutions we may find in our own approach will have greater effect on the traffic safety problem than any other. This cannot be accepted as truth. No simple, single solution will suffice to solve one of man's most complex and costly problems—increased mobility.

2. This shortsighted approach is attributable, to some extent, to our inability to make long-range plans because of the usual short-term provisions for research funds. Often when a project is nearing its most productive period, its principal investigators are diverted from the tasks of research to solicit new funds, or to show justification for continuation of grants which are about to expire. In our opinion, one of the most important of all traffic safety research needs is provision for long-range research grants. Federal agencies or philanthropic foundations are ideally suited to answer this need.

3. We at ACIR believe that the three basic concepts or objectives of traffic safety research already outlined are inseparably interlocked, in the sense that none of them affords full solution, and all must be attained if the fundamental problem is to be solved. If this is accepted, then the most segmental research discipline represented here today must admit the possibility of conflict between individual research freedom and common research responsibility. In our opinion, the aims of all of us present could be immeasurably advanced if each of us were willing to subscribe to the following conditions:

(*a*) Establishment of some form of central agency or agencies, charged with the responsibilities of providing uniform standards of data collection, identification, and interpretation of that data, and serving as a communications clearinghouse and a coordinating nucleus for all activities in the field of traffic safety research.

(*b*) Formation of National Advisory Committee on Highway Safety Research, with authority to review and evaluate individual project proposals, and to assign to them recommended priorities for long-term grants, on the basis of their potential for contribution, as "scientific tools" to subsequent research, and their potential to produce findings directly applicable to the measurable reduction of traffic accidents, injury, and death.

4. At first glance, the cost of maintaining all the disciplines essential to such coordinating centers might be thought to be prohibitive, if they existed only for traffic safety research. Fortunately, the essential research elements are already available in our major university centers, which are able to afford the services of distinguished specialists in all disciplines pertinent to the proper study of man, machine, and environment. The concept of interlocking research disciplines is already familiar to such institutions, and there should be no obstacles to the coordination of various disciplines for the investigation of interrelationships between the diverse factors affecting traffic safety. At Cornell University, a center for highway safety research based on these principles has been organized. Data collected by ACIR is accessible, through the coordinating influence of the Cornell center, for a panuniversity program of operations research and analysis of traffic safety factors.

5. With additional funds, ACIR could provide data to research centers other than Cornell University. Its data collection program could be extended to provide uniform samples of representative data on a national scale, which is the only possibility for statistically reliable studies of interrelated accident and injury factors involving man plus machine plus environment. The scope of the collection program could be broadened to include new types of data on accident causes, and the risks associated with various types of exposure. The value of a scientifically balanced and nationally representative program, capable of producing large volumes of uniform data suitable for use by numerous research groups throughout the country, deserves careful consideration. The total budget

for such an operation would approach $1 million, and a large part of this amount has already been obtained by direct solicitation for the period of the next fiscal year. Viewed in terms of its extraordinary potential both for contribution to subsequent research and for measurable reduction of traffic accident, injury, and fatality tolls, we believe that such a program may be recommended as a top priority candidate for long-term research grants. However, the decision is not ours to make. The present lack of perspective in the field of traffic safety research is such that it may be said of any of us, with some justification, that we "can't see the forest for the trees." Since it is possible that ACIR is no exception, we can ask no more than the evaluation of our particular needs within the context of the total traffic safety problem.

Thank you.

EXTENSION OF THE ORAL PRESENTATION OF JOHN O. MOORE, DIRECTOR, AUTOMOTIVE CRASH INJURY RESEARCH, CORNELL UNIVERSITY MEDICAL COLLEGE, NEW YORK CITY

Dr. McFarland, honorable members of the subcommittee, respected colleagues, after due thought and consideration, the staff of automotive crash injury research has reached a unanimous decision that we should be remiss in our obligations if our remarks today were restricted entirely to our own area of research. It is our sincere opinion that present research needs cannot be realistically assessed unless we take cognizance here of a deeply buried problem which adversely affects all of our efforts. Even if the need for funds were discussed by every speaker here today, and these funds granted freely and without stint, the result might well be a perpetuation of the very inadequacies which have prompted the subcommittee to call us together here. I am convinced that the particular needs of each of us are secondary to the overall need for an effective program of traffic safety research, and that no presentation or plea offered today can be considered into itself. I therefore propose, with your permission, to discuss first the overall problem, and then the particular needs of ACIR, since the two are irrevocably wedded.

OBJECTIVES OF TRAFFIC SAFETY RESEARCH

It is probable that there is no field of honest research today in which the lack of perspective is more nearly total than that of traffic safety. Our critics might say of us all, with some justice, that we "can't see the forest for the trees." They might also claim with reason, that we seldom provide evidence of thinking in terms of pure principles. With this in mind, I wish to introduce at this time three concepts or objectives which, in our opinion, are unquestionably fundamental to both present and future research in traffic safety:

1. We seek to select and control the individual best suited to drive, by—
   (a) weeding out irrevocable defectives; and
   (b) educating or altering those who are reclaimable.

This we attempt to do by acquiring research knowledge which can be used to measure human attitudes, human judgment, and their consequence, human behavior. In short, we try to control man.

2. Realizing that our ability to control man is, and will probably remain, always limited and often temporary, we also seek to broaden the areas in which there is neither need for, nor possibility of, human intervention. In this second approach we require research knowledge to direct the application of principles of automation in our efforts to improve highways, vehicle controls, and traffic supervision. Generic examples of automation in these areas are:
   (*a*) Nonintersection highways;
   (*b*) Use of radar devices to limit driver decisions; and
   (*c*) Use of radar in traffic control and enforcement.

3. Finally, admitting the possibility that, even if total automation could be obtained, it would remain subject to misfunction, we seek to "immunize motor-vehicle occupants against the possible consequences of exposure to crash injury. In this third method of approach, we are no longer concerned with preventing accidents from taking place, but rather with protecting the occupants when a failure occurs in our accident-prevention efforts. Therefore, our objective here is to contain the occupants of accident-involved vehicles within a compartment or "package," designed to afford maximum

protection under crash conditions. To do so, we require research knowledge enabling us to identify the more common types of accident in which occupants are exposed to the greatest crash injury risks. We also require precise knowledge of the direct agents or cause of injury in these accidents, so that the attention of automotive engineers can be directed to aspects of design commonly associated with injury.

LONG- AND SHORT-TERM GRANTS

At the present time the majority of funds for research in traffic safety, are allocated on the basis of yearly, or short-term, grants. The continuation of these funds is largely determined by the amount of time which project directors and other top research personnel devote to fund-raising efforts, and to some extent by sheer weight of personality. The result is that, as a project moves closer to its research goals, the principal investigators are constantly being diverted from the tasks of research planning and execution in order to solicit new funds or to show justification for continuation of expiring grants. The solution to this pressing problem, which affects us all alike, would be provision for research funds for longer continuous periods.

Proper examination and consideration of proposals for long-range research funds assure proper integration and maximum utilization of results. Federal or philanthropic foundation support is ideally suited to answer this need for long-term grants.

COORDINATED APPROACH TO TRAFFIC SAFETY RESEARCH

It is the opinion of the staff of automotive crash injury research that the 3 objectives just outlined are inseparably interlocked, in the sense that all 3 must be attained if the basic problem is to be solved. If this is accepted, then the most isolated and particularized discipline represented here today must admit the possibility of conflict between individual research freedom and common research responsibility.

Automotive crash injury research, with every intention of preserving the traditional freedoms, believes that it is the responsibility of each of us here to place our common needs ahead of our individual requirements, by subscribing to the following conditions:

1. The establishment of some form of independent central agency or agencies having responsibility for—

(*a*) maintain a complete traffic safety reference library;

(*b*) providing a clearinghouse for the free exchange of research information in this area of activity;

(*c*) compiling a dictionary of traffic safety research terminology, designed to implement the development of a common vocabulary;

(*d*) outlining specifications designed to provide for uniform methods of data collection, data identification, and data interpretation;

(*e*) investigating possible means of supplying, for research use and on a public-service basis, certain types of vitally needed data which are now available only commercially, and at a cost which is prohibitive for the majority of nonprofit research organizations; these data, for example, show monthly increases in vehicle registrations by State of registration, and are available within approximately 1 month after the period covered; and

(*f*) furthering the development of an apparatus for collecting representative samples of uniform data on motor vehicle accident and injury causes on a national scale; such an apparatus is essential if we are to—

(1) obtain knowledge as to the risk, or chance, of an event occurring among all the circumstances in which such an event is theoretically possible; and

(2) provide for uniform data enabling us to measure, simultaneously, causal interrelationships between man, the vehicle and the highway environment which are believed to influence the occurrence of accident and injury.

2. Automotive crash injury research also recommends the formation of an Advisory Committee on Research Needs, to review and evaluate individual project requests for available funds, and to assign recommeded priorities for long-term grants on the basis of the following considerations:

(*a*) The value of the proposed project as a tool for, or prerequisite of, subsequent traffic safety research;

(*b*) The existing potential for implementation of a given project's eventual findings, in order to bring about a direct and immediate reduction in the national traffic fatality and injury rate; and

(*c*) The value of the proposed project as a tool for, or prerequisite of, subsequent research in areas other than traffic safety.

USE OF EXISTING FACILITIES FOR COORDINATION

It is unlikely that any funding source other than the Federal Government or some major philanthropic foundation could even consider supporting the multiple sciences and research disciplines essential to a coordinated traffic safety research program, if such facilities were brought together for this one purpose only. However, the fundamental disciplines for such a program already exist: The major university centers of our Nation can call upon the services of distinguished specialists in fields of research pertinent to the proper study of man, the machine, and the highway environment. Furthermore, the concept of interlocking research disciplines is a familiar one to these institutions. At Cornell University, for example, a Center for Highway Safety Research has recently been organized, through the office of the vice president for research, on the basis of the very principles which we have recommended today for the consideration of the subcommittee. Information supplied through an interstate data-collection program, built up during the past 5 years by automotive crash injury research, is now accessible through the Cornell center, for a panuniversity program of operations analysis and research. Since the research disciplines essential to such a program already exist at the university, the budget required to operate such a program is relatively small. It is estimated that a 2-year budget for a pilot program of traffic safety research, excluding the operating cost of automotive crash injury research, would come to some $400,000.

This figure provides for the allocation of $25,000 per year to salaries and office operations, with the entire balance of $350,000 spent in research. Similar programs are undoubtedly feasible on other campuses as well, if access to comparable quantity and quality of data can be obtained. Programs not requiring access to mass data of the kind provided through automotive crash injury research have already been initiated at other universities, as well as at Cornell, and these can readily be expanded, together with the Cornell program, in a coordinated approach, if the concept of an interlocking attack on the problems of traffic safety is accepted as valid. Given uniformity of data collection and interpretation methods, independent research findings from numerous and varied sources and disciplines could be combined, and interrelationships analyzed and reliably interpreted.

I should like now, since our time is limited, to present the specific needs of the present automotive crash injury project, as distinguished from those of the Cornell University Center for Highway Safety Research, which will be outlined to you in greater detail by other members of the center's governing board.

A major portion of the funds available to automotive crash injury research, during the 5 years of its present existence, has been utilized for the establishment, development, and maintenance of a data-collection apparatus, which now operates in 75 sampling areas distributed over 16 States. This apparatus is currently supplying an annual volume of usable accident and injury case data from 10,000 to 12,000 accident-involved cars each year. Aside from funds spent in assuring the present satisfactory level of general data input, most of our money has been spent to train and equip our technical staff for the task of machine processing of mass quantities of data, and the use of recognized scientific statistical techniques for data interpretation. The data presently available are such that we have been able to schedule a major program of research and data output covering the next 2 years, if funds are available to hire additional personnel qualified to assume responsibility for interpreting and analyzing technical data and for the writing and producing of finished reports. This would be our first object in seeking additional funds.

Our second need is to increase the volume of certain types of data already available, in limited amounts, and particularly to acquire data on recent-model cars at a greater rate than is possible in terms of the present data-collection program. The faster we can obtain mass data from accidents involving cars with safety-oriented design components, the faster we shall be able to evaluate the influence of these changes on the risks of occupant injury and fatality. This can only be done on a reliable basis by considerably increasing the size of the

sampling areas in which data on recent vehicles is collected. Funds are needed to hire additional field representatives and to provide a greater volume of training materials in order to expand the present data-sampling areas.

Our third need is to extend the scope of our project investigation in order to incorporate entirely new types of data. At present, there are many factors, influencing both the occurrence of motor-vehicle accidents and their human consequences, whose real effect we are unable even to estimate, because the full count of the "populations" involved is still unknown. In other words, while we can determine how often these factors are present in the accident population, we have no information to indicate how often they are present in the entire driving population, of which the accident population is only a small part. Without such information, we are unable to determine the relative importance of these factors as causes of accident. The technical term for the type of information needed is "exposure data." For example, one type of exposure data which has yet to be satisfactorily determined on a sufficiently broad basis is concerned with speed. While the statement that "speed kills" may serve some purpose as a deterrent to violation of existing speed laws—especially where backed up by vigilant traffic control—we cannot test the validity of this assertion until we have learned what proportion of the national "speeding" population is and is not involved in fatal accidents.

Automotive crash-injury research is now prepared to measure certain limited aspects of exposure. Since a project of this size cannot undertake to provide all types of exposure data; we have selected those elements which are particularly pertinent to the packaging concept, which is our own field of research specialization.

Among these elements are certain basic or generic factors such as speed. In addition, we shall attempt to obtain exposure data on year, make, and body style of car, with relation to injury. Exposure data for measurement of possible associations between accident occurrence and the presence or absence of various power assists—i. e., brakes, steering, etc.—is also contemplated. Further arrangement has been made for possible exposure studies exploring associations between highway design and accident occurrence.

While automotive crash injury research operations in the past have been primarily concerned with measuring the influence of packaging components as injury causes, the apparatus for obtaining exposure data, and to some extent the data itself, is already available through the interstate data-collection system. The project staff is aware of the extraordinary potential for a comprehensive investigation of accident causes, which is implicit in the nature of its data-collection apparatus. However, present limitations both of IBM equipment and available technical personnel impose severe restrictions on the exploitation of this potential. The budget required to operate the project for crash injury research at present is $494,480 per year.

Addition of a program for the investigation of accident causes on a reliable statistical basis cannot be contemplated without substantial amounts of additional funds. However, the value of a scientifically balanced and nationally representative program, capable of producing large volumes of uniform data suitable for use by numerous research groups throughout the country, deserves careful consideration. Viewed in perspective, against the magnitude of the traffic-safety problem which confronts us, a total budget approaching $1 million per year does not appear excessive, if it can provide for a combined program of uniform data collection and research, covering both accident and injury causes on a national scale. Further, in reckoning the account we should not overlook the national saving, in terms both of manpower and of property, which could be expected to result from the success of such a program.

In conclusion, I should like to reemphasize that the particular needs of each of us must be subsidiary to the need for an overall, coordinated program of traffic-safety research if we are to succeed in attaining our prime objectives. It is the opinion of automotive crash injury research that neither its own needs nor the needs of any other specific project can be properly evaluated except in the context of the total traffic-safety problem. Thank you.

(Prepared by the staff of automotive crash injury research department of public health and preventive medicine, Cornell University Medical College, 316 East 61st Street, New York City.)

Dr. McFARLAND. I am next going to call on Col. John Stapp, a man who is, indeed, an extraordinary person. I would like to emphasize if research is to be done it must be done by men who have knowledge

and training such as Colonel Stapp. He is a doctor of philosophy in biophysics and also a doctor of medicine.

It seems to me that he has brought an admirable combination of training and experience into his research position. He is going from Holloman Air Force Base to Wright Air Development Center, where he will be Director of the Aeromedical Research Laboratory.

John has a very fundamental interest in problems of highway safety as well as a research in the air and he does, in my opinion, combine wisdom and courage and knowledge, which is so necessary in research in this field.

It is a great pleasure to introduce him.

STATEMENT OF COL. JOHN P. STAPP, DIRECTOR, AEROMEDICAL LABORATORY, WRIGHT AIR DEVELOPMENT CENTER, DAYTON, OHIO

Colonel STAPP. Dr. McFarland, thank you for your kind words.

Mr. Roberts, members of the committee, panelists, I would like to bring up the subject of salvage. I refer to salvage of victims of accidents in terms of preventing injury and death or, at least, mitigating injury.

The research I refer to has the following approaches:

One, determining human tolerance limits to mechanical force; determining injurious and lethal levels of mechanical force of the type incurred in accidents with animal experiements; and evaluating protective devices.

Any device put into an automobile that will mitigate injury or prevent death by attenuating mechanical force or by restraining the occupant is of the nature of the device that we investigate. We have found in research applicable to motor vehicles during the last 5 years that the lap belt impacts against the pelvis can be tolerated up to 4,600 to 4,800 pounds by healthy human volunteers and that considerably higher forces will begin to result in injury with applicable animal subjects. We have tried the chimpanzee and the hogs in the 175- to 200-pound weight range.

More recently we have tried black bears, because they have a pelvis structure most similar to that of man. They have a flexible spine and neck and the weight and balance of the body is more comparable to that of man.

This research has been done and is continuing to be accomplished by an Air Force agency which has a background of experience in aircraft-crash research which differs not too much from vehicular crash and a group that has a tradition and precedent for using human subjects, human volunteers, in evaluating protective devices. That is the ultimate measure of the adequacy of a protective device and certainly a way of certifying it for human use more realistically than can be done wtih dummies, animals, or similar simulators.

While many other agencies have been doing experiments on crashing vehicles, dummies, making the force measurements, the answers as to tolerance and to effectiveness of protective devices still must relate to direct human experimentation.

This research has been carried on with a certain amount of difficulty in terms of Air Force monetary support and with an absolute im-

possibility, of course, of receiving other support, since it is a military research function and support is dwindling to nothing presently because of higher priority commitments in other fields.

It is essential in terms of Air Force needs that as little as 20 cents per man per year be spent in an attempt to reduce the death rate of close to 700 per year and an injury rate which constitutes our highest hospitalization cost in the Air Force.

Furthermore, this research is applicable to civilian crash problems and the information is made freely available to any competent civilian agency that requires it.

Although I have been transferred from Holloman, my interest in promoting and keeping this research going continues and we have competent research workers still at work at Holloman who can continue the program. We have a strong effort going on at present to determine as well as possible the lethal limits for the lap belt using the black bear, and this research will continue as long as support is available.

Thank you.

Dr. McFarland. I am next going to call on two men who direct research at large universities. Both of these men, Mr. Baker and Mr. Mathewson, are engineers. They both have had many years' experience in this field and can speak with a great deal of wisdom and background.

I am first going to call on Mr. Baker.

STATEMENT OF J. STANNARD BAKER, DIRECTOR OF RESEARCH AND DEVELOPMENT, TRAFFIC INSTITUTE, NORTHWESTERN UNIVERSITY, EVANSTON, ILL.

Mr. Baker. In the name of safety about $75 million are collected yearly from drivers for licenses. An additional indeterminate amount, probably of the order of $200 million, is collected in fines and bail forfeitures. Also for traffic safety, money is spent for driver-license administration, traffic police, and traffic courts. The total amount is unknown but it probably exceeds that collected in license fees and traffic fines.

It is a tenet of American culture that money spent for traffic supervision prevents accidents. Yet few beliefs so firmly held are so ill supported by solid facts. Hence administrators of traffic supervision and legislative bodies who authorize funds to pay for it have little to guide them today on how much they should put into driver licensing, traffic law enforcement, and similar activities.

I would like to point out some research needed to improve efficiency of efforts in behalf of safety of agencies given the responsibility, of controlling drivers on the road.

In the first place, although not itself research, some systematic nationwide information on the amount and kind of traffic supervision will be needed for close evaluation of safety programs by any means that a scientist might apply. Nobody knows, for example, how much is being collected in fines or assessed in jail sentences by various jurisdictions for various offenses.

Medical, psychological, and sociological researches proposed by others will eventually contribute to the technology of traffic supervision. They should be encouraged.

I would like to emphasize, however, that increasingly we should study traffic accidents themselves to learn what deficiencies in roads, vehicles, and especially in driver personality contribute. The Traffic Institute is conducting a pilot study for this purpose which will be of little significance unless a large-scale continuing study follows it.

I would like also to emphasize that although basic research in many fields, especially in that of human behavior, are necessary, it is also important that operations research be carried out if we are to get full benefits of such basic research.

As mentioned in connection with education, research findings must be developed into operating procedures because, generally speaking, the people undertaking administrative functions are not in a position to take scientific data and from it devise effective procedures.

May I, in addition, emphasize that a central plan for traffic safety research is needed. Several departments of the Federal Government, many States, some private organizations, and a few official associations do research useful for traffic. These various agencies are chipping away at the problem separately. With united efforts through modest coordination they could chop at the problem rather than chip.

Finally, I would like to point out that progress to date in reducing accidents by whatever means people responsible for it command has been very substantial.

Under more or less rule-of-thumb safety programs accident rates per mile of driving have diminished in the last quarter of a century very substantially. From now on those in the field of traffic law enforcement and driver license administration, are confronted with the problem of determining which rule-of-thumb methods used in the past got results. They must sharpen their tools by research so that they may make further inroads upon our great traffic problem.

(The complete statement follows:)

Research for Traffic Supervision

Statement by J. Stannard Baker, Director of Research and Development Traffic Institute, Northwestern University

Traffic supervision is the work of police courts and driver license authorities. In the name of safety, about $75 million collected yearly for driver licenses and an indeterminate additional amount, probably of the order $200 million is collected in fines and bail forfeitures. For the same purpose money is spent for driver-license administrators, traffic police, traffic courts. The total amount is unknown but it probably exceeds that collected in license fees and traffic fines.

It is a tenet of American culture that this money and accompanying traffic supervision prevents accidents. Yet, few beliefs so firmly held are so ill supported by solid facts. Hence administrators of traffic supervision and legislative bodies who authorize it and funds to pay for it have little basis for judging adequacy of this activity. For example, how many lives and how much expense could be saved if we doubled our efforts in traffic supervision? Would another dollar per driver per year spent on vehicle inspection reduce accidents more than the same amount spent on additional driver licensing or traffic police, and if so how much? How can people supervising traffic do their work more effectively? Those working in this field are groping for answers to such questions.

Basic Information

Although not of itself research, systematic nationwide information on results of traffic supervision will be needed for close evaluation of programs of various kinds and intensity. Nobody is now, year by year, tabulating the number of arrests and citations for traffic law violations, the number and amount of fines and jail sentences resulting, or the number, duration, and kinds of license with-

drawals. Many data of this kind are produced by States, counties, and cities but continuous, nationwide, systematic compilation on a uniform basis will be needed to make such data stuff to nourish research.

ENFORCEMENT

Fear of accidents alone is not enough to deter many from unsafe behavior; accidents are too infrequent and too much a matter of chance. But fear of enforcement is an effective additional deterrent; apprehension for a traffic offense is 10 times as likely as an accident, and being cited by a traffic policeman is no chance.

Yet we know little about the complex psychological processes involved in modifying human behavior by apprehension and punishment. Almost no facts are available about how many and what kinds of traffic offenses result from simple ignorance, are inadvertent acts, or are willful disobedience. Nor do we know the effect of police and court activity on each kind. Will fewer arrests and bigger fines or more arrests with fewer fines be a more effective deterrent? Will concealed enforcement get greater results for the cost than open enforcement? Administrative problems also need research. How can available traffic police officers best be deployed? Should they be evenly distributed over the road network at all hours? Should they be assigned according to traffic volume or accident experience? Would short intensive enforcement drives result in more effective driver control than steady or continuous pressure? Only research can tell us how to get the most out of our present expenditures for traffic supervision.

DRIVER LICENSING

In theory, drivers have accidents because of deficiencies in natural abilities, knowledge, skill, or attitudes, and examinations will weed out the unfit. But when administrators seek tests to separate fit from unfit they find few, and for these there is not much scientific basis for establishing the point below which an applicant must be considered an intolerable risk.

Hence decreasing accidents by tightening up examinations cannot be successful until research has produced better tests and more precise definitions of permissible minimum scores. Simply giving more tests and scoring them more closely results in complaints—sometimes in court—of being arbitrary and capricious.

Largely for lack of defensible techniques for discovering drivers with unfavorable records, evaluating their risk, and prescribing corrective measures, dealing with such drivers has tended recently to become an adjunct of enforcement in which a point-system formula based on violations establishes a suspension as a punitive measure.

GENERAL CONSIDERATIONS

Certainly medical, psychological, and sociological research proposed by others will contribute to the technology of traffic supervision.

Increasingly we should study accidents themselves to learn what deficiencies in personality contribute. The Traffic Institute is conducting a pilot study for this purpose which will be of little significance unless a large-scale continuing study follows it.

Necessary as it is, research in various fields of science will not automatically improve traffic supervision. In the thousands of independent police departments and courts and in the scores of driver license divisions are few people who can translate research findings into operating procedures. Operating research must be provided if benefits of more basic research are to effect traffic supervision in time to save many lives in our generation.

A central plan for traffic safety research is needed. Several departments of the Federal Government, many States, some private organizations, and official associations do research useful for traffic safety. These various agencies chip away at the problem separately. With united efforts through a modest amount of coordination they could chop at the problem rather than chip.

Dr. McFARLAND. Thank you very much.

Our next panelist is Mr. Mathewson, who is professor of engineering at the Institute of Transportation and Traffic Engineering at the University of California. He is connected with both branches of the

university. He sometimes is at Berkeley, and I think next year he will be at Los Angeles, as you know it is the same institution and the same able person.

STATEMENT OF JOHN R. MATHEWSON, PROFESSOR OF ENGINEERING AND ASSISTANT DIRECTOR, INSTITUTE OF TRANSPORTATION AND TRAFFIC ENGINEERING, UNIVERSITY OF CALIFORNIA, BERKELEY, CALIF.

Mr. MATHEWSON. Chairman Roberts, members of the committee, Mr. Moderator, fellow panelists and guests, the Chair has indicated that time needs to be conserved for the presentation of these statements. In harmony with this expressed wish, I shall limit my remarks to a few brief extracts from the statement I have prepared.

I ask the privilege, however, of having the prepared statement accepted for the record.

Mr. ROBERTS. Without objection, that may be done.

(The statement referred to follows:)

STATEMENT OF JOHN H. MATHEWSON, PROFESSOR OF ENGINEERING AND ASSISTANT DIRECTOR, INSTITUTE OF TRANSPORTATION AND TRAFFIC ENGINEERING, UNIVERSITY OF CALIFORNIA

Mr. Chairman and members of the committee, my name is John H. Mathewson. I am professor of engineering and assistant director of the Institute of Transportation and Traffic Engineering, University of California. The statement I shall make today is my own, but in essence it is representative of the belief of my associates in the institute but is not necessarily the viewpoint of the university. Your committee has already accorded to a member of our staff the privilege of testifying before it on one of our major efforts, namely, automobile collision injury research. I shall, therefore, confine my remarks to areas of our research not heretofore reported to you, and even then only to those we consider especially pertinent to what we believe to be the objectives of your committee.

Currently, and this applies to our activities during all or some portion of the past 10 years, we are pursuing research in—

1. Driver behavior.
2. Analysis of mass accident statistics.
3. Theory and simulation of traffic flow.
4. The development of a driving simulator.

Although the initiation of specific studies in each of the foregoing areas depends upon the imagination of some one individual, we find that accomplishment is better attained through teamwork than by independent individual effort. We recognize, too, that we are dealing with a system consisting of man, vehicle, and exterior (to the vehicle) environment and that in the dynamic state on our streets and highways the study of one to the exclusion of the other two is seldom possible on any rational or logical basis.

Highway transportation is thus made up of a number of different elements, each with its own characteristics, and between which there is a wide variety of interactions. During motion, roadways and everything else in the outside environment is constantly changing, vehicles vary as to make, model, year, and condition, etc., and man, the driver, varies from one end of the spectrum of human performance to the other. In the latter regard there is a wealth of evidence to indicate that most of us oscillate widely in the spectrum depending upon our minute-to-minute and day-to-day moods, troubles, desires, and temperaments. Pertinent studies must comprehend all of these matters, and it will thus be clear that many competencies are required and just as clearly they are not confined to any one discipline. Recognizing this situation, we utilize a variety of disciplines in our research. These include psychologists, physicists, mathematicians, and a variety of professional engineers. On occasion, moreover, we have conducted studies in the course of which we found a need for knowledge in still other disciplines or subdisciplines. We have thus had, or

currently have, specialists in two areas of medicine, physiologists, and experts in instrumentation, vibration, and operations research associated with us on some of our projects.

Unlike most lines of human endeavor, research can make no promise of specific findings in advance. Quite often the results are inconclusive, thus indicating the need for additional research, and just as often they are negative. Even when negative they are valuable in that they are especially helpful to anyone doing research then or later in the same field or in some other field where similar procedures or methods might be used.

A recurring difficulty in much of our research stems from two considerations. One is that in studies of the driver in the real system the experimental conditions are constantly undergoing change and cannot be controlled or, therefore, faithfully reproduced. Measurements under such conditions are quite incompatible with research requirements. We therefore proceed to the alternative, and really this is our first choice, of bringing the problem in its entirety into the laboratory where we can exercise the necessary control and exactly reproduce the phenomenon under study as often as we please. This is not to say that the setup in the laboratory looks exactly like the real system but rather that its behavior or performance is sufficiently similar to give us some degree of assurance that our experimental results would be valid in the real system. The final or acid test, of course, is to attempt a validation study in the real system.

Bringing the driving task into a laboratory, however, is a major undertaking. Nevertheless, we have been pursuing such an idea for a number of years and during the past year, in particular, some components have been procured, some preliminary studies made, and a considerable amount of design work completed. I am here referring, of course, to item 4 above; namely, a driving simulator. With such a device as a research tool we we visualize being able to conduct studies of driver behavior with findings having enormous potential value in all aspects of the street and highway transportation system.

Another of our major projects is the development of a theory of traffic flow in order that there may be available an adequate body of knowledge for more rational design of the system. In saying this we are not condemning the present system. Clearly, it works amazingly well but not well enough as is evidenced by the annual "overhead" in terms of lost lives, destroyed property, and time losses stemming from accidents, congestion, and malfunctioning generally. The action of the House of Representatives in constituting your committee and setting forth its task, with the concurrence and support of the Senate, provides all the additional evidence we need that the operation of our street and highway network is essentially unsatisfactory. Moreover, we all know we possess the ability to bring about a vast improvement. The crux of the problem, perhaps, is how to bring our resources to bear on the problem. Our research group is greatly concerned with system efficiency which, in other words, means expeditious travel with economy, safety, convenience, and reasonable comfort.

Again, because of many inherent difficulties in studying the real system, we have attempted and, on what might be termed a pilot basis, we have been successful in subjecting the problem to study in the laboratory. This we have done by simulating the flow of traffic on high-speed electronic computers. A very small number of contemporaries in several other universities are working on altogether similar concepts. One of the most notable is at the University of Michigan where the work is being directed by Prof. Harry Goode.

There are a number of sound reasons why studies such as those just indicated should be greatly accelerated and expanded. We are not now keeping abreast with current problems. Indeed, it is extremely doubtful that we are even catching up on them. Furthermore, expert predictions on future population growth of both people and automobiles clearly spell further deterioration unless we see fit to take a forthright and rational approach which automatically includes adequate funding.

The employment of high-speed computers for traffic simulation studies is costly or cheap depending upon one's viewpoint. It will appear costly if we view it as so many dollars for an outcome that cannot, in advance, be described in detail with a guaranteed label. It will appear cheap if we view it in terms of the potential gain in knowledge we do not now have, in that such knowledge will enable us to effectively cope with a national problem that is serious now and which promises to accelerate in seriousness in the immediate and more distant future.

In conclusion, Mr. Chairman, I wish to say that in my opinion, as a nation, are not devoting more than token resources to research on the key aspects (of the traffic problem) I have alluded to in my testimony.

Our organization, as part of a State university, is fortunate in having the understanding and support of a generous State legislature backed up by a like-minded citizenry. Even so, there are limits and with moderately increased resources we feel we could significantly accelerate our progress toward vitally needed improvements. Research was born, cradled, and developed to its present stature in universities. Within our universities many highly competent people could be readily induced to undertake studies in the areas I have discussed provided funds were available. I have not made any study of the amount that might be judiciously allotted annually for systems-type studies centering around man in the street and highway transport environment. I would be willing to guess, however, that a figure between $3 million and $5 million per year for the next 2 or 3 years would not be too much. A reappraisal would then be in order to determine the adequacy of such expenditures. In its wisdom, the Congress earmarked 1½ percent of the highway appropriation for surveys and planning. Thus far the controlling agencies, both Federal and State, have not construed this to include support for studies such as I have indicated. Unless funds are to be quickly provided in some other manner, it would seem that amending legislation is needed to make it clear to the controlling Federal agency that support for research such as I have described constitutes legitimate use of moneys from the 1½ percent earmarked funds I referred to above.

Mr. MATHEWSON. In my organization, the Institute of Transportation and Traffic Engineering of the University of California, we are concerned with virtually all forms of transportation. Consequently, we perform research on a correspondingly broad scale.

In the conduct of studies of driver behavior or driver performance, we have repeatedly found that really promising lines of research have had to be abandoned because we did not have research facilities capable of reproducing the street and highway driving environment under controlled conditions.

As a partial solution to the establishment of the necessary study conditions we propose the development of a driving simulator as has been mentioned previously, and we have been devoting a substantial amount of effort on such a development during the past year. There are other studies, such as those concerned with vehicular movement patterns, in which simulation—of the system—is a powerful tool. This is particularly true of those studies that cannot logically or scientifically or safely or legally be performed in the real system with reasonable speed, economy, or adequacy of experimental control.

As a matter of logic and efficiency, we prefer to perform our studies in the laboratory and to confine our field activities to the measurement of needed constants and ranges in variables except where we must eventually go into the field situation or the real world in order to validate findings from our studies.

Thus another of our research activities is aimed at simulating traffic flow on an electronic digital computer which has also been referred to previously.

We and some of our friends have had some preliminary success along these lines.

Here again, however, we encounter a very real problem. The first I mentioned was going into the real world to make studies in the first place. The second I shall now dwell upon. This is financial support.

In the use of electronic computers or high-speed computers it costs money. It costs a great deal of money, and this kind of money simply is not forthcoming today.

I think I can safely say, without much fear of challenge, Mr. Chairman, that there is one frontier that has not been closed in this country and that frontier is that there is still a reservoir of slave labor. This is available in the universities and colleges of these United States where more can be purchased for a dollar than anywhere else on the face of the globe.

That concludes my statement, Mr. Chairman.

Dr. McFarland. Thank you very much.

We have two remaining panelists. I am next going to call on Mr. Holmes, who is Assistant Commissioner for Research of the United States Bureau of Public Roads.

It is a great pleasure to have you here. I know of your great interest and support of research in this field.

STATEMENT OF E. H. HOLMES, ASSISTANT COMMISSIONER FOR RESEARCH, BUREAU OF PUBLIC ROADS, DEPARTMENT OF COMMERCE

Mr. Holmes. Thank you, Dr. McFarland.

Chairman Roberts, we have a statement that I should like to supply for the record but I will just read briefly some excerpts from it, in the interest of time, if that is appropriate.

I feel sure it is a very good statement because almost everything in it has already been said his morning, much better than it is said here.

We fully agree with the opening speaker, Dr. Dunlap, that the nature of traffic safety research needs follows the major components of the accident problem; that is, the human being, the highway and the vehicle. We have discussed mostly this morning the human being, so I should like to refer particularly to those other components: The highway and the vehicle. These are products susceptible of refinement safetywise chiefly by research and development engineers.

Regardless of the role of the human factor, the highway and vehicle are frequently involved as contributors to accidents. Just how will not be understood without research.

At the present time there are more than a dozen States cooperating through their State highway departments with the Bureau of Public Roads in studies on the highway that we hope will reveal new and badly needed facts on the relation between speed, horsepower, and driver behavior. This work is being done in connection with the study of the highway safety called for under section 117 of the 1956 Federal-Aid Highway Act.

Having had these contacts of long-standing among State and local highway officials, motor vehicle departments, police and traffic engineering officials, and others in responsible positions, the Bureau feels a national responsibility and interest in furthering traffic safety research.

At the same time, the special talents of the behavioral and medical scientists have been recognized by their inclusion in cooperative research undertakings.

One example of this cooperation is the interdisciplinary study of traffic accident causes for which the Bureau of Public Roads is supplying major financial assistance along with the United States Public Health Service and the Automotive Safety Foundation. Another is

the joint effort with the Department of Health, Education, and Welfare in developing facts from their national health survey to define the dimensions of the national traffic accident toll.

If additional emphasis is to be projected for traffic safety research, the Bureau would welcome a continuation and extension of relations of the types cited. Past experience has proved that this joint work typically produces valuable returns.

A somewhat broader point has also been under consideration during the Bureau's work on the highway safety study.

I should like, on behalf of the Bureau of Public Roads and the Department of Commerce, to emphasize the statements made by Dr. Brandaleone and others of the need for some central organization which might coordinate and encourage work in this field of traffic safety.

That agency might be set up as an independent agency, perhaps called a Highway Safety Research Board or some name such as that, by the Congress; or possibly the responsibility could be vested in some existing agency.

I think particularly of the National Research Council of the National Academy of Sciences. Some such group could certainly provide an effective and most useful force in this whole field of traffic safety research if it could bring together the research needs and try to direct to those needs, with established and reasonable priority, the resources that are now available in the way of funds, and skills in universities and elsewhere; and would perhaps be better able than all of us working individually to appraise the results of needed additional support.

Thank you.

(The statement referred to follows:)

STATEMENT OF E. H. HOLMES, ASSISTANT COMMISSIONER FOR RESEARCH, BUREAU OF PUBLIC ROADS, DEPARTMENT OF COMMERCE

The nature of traffic safety research needs rather logically follows the three major components of the accident problem, viz, the human, the highway, and the vehicle.

The human component is a complex factor, difficult to assess in terms of absolute responsibility for an accident. In a broad sense, however, it can be said that accidents of all types stem from faulty human behavior. Any research is therefore pertinent to traffic safety if it seeks better understanding of man's knowledge, attitude, skill, physical condition, and similar criteria as they relate to accident causation. The field of the behavioral scientist is thus identified as one of legitimate importance to traffic safety. Fundamental human data obtained in accident research have application in home and industrial environments, and if properly interpreted, might contribute to an improved understanding of why traffic accidents occur. The extent of this type of research that has been directed toward the highway accident problem has not been great.

The other two components of the traffic accident, the highway and the vehicle, are products susceptible of refinement, safetywise, chiefly by research and development engineers. Regardless of the role of the human factor, the highway and the vehicle are frequently involved as contributors to accidents. Just how is not and will not be well understood without more intensive research. The driver and his vehicle, in motion, are essentially engineering problems, for they involve the time and space considerations customarily subjected to engineering analyses. Thus traffic safety research has a particular meaning for those involved in the task of building highways and vehicles. It is in these two tangibles that engineering research can find specific and effective expression.

The Bureau of Public Roads is proceeding with a study and investigation of highway safety in accordance with the provisions of section 117 of the Federal-Aid Highway Act of 1956. The objective is to determine what Federal action can be taken to improve highway safety. The highway safety study is

not yet complete and the views expressed here must be accepted as representative only of current thinking based on our investigation and study activities up to this time. A formal report is to be submitted to the Congress by the Secretary of Commerce by March 1, 1959.

Satisfaction of research needs has a high priority in any consideration of Federal action on behalf of highway safety. In its administration of the national highway program, the Bureau has established strong and effective relationships with the State agencies chiefly responsible for official safety programs. For more than two decades, a series of traffic and safety researches have been conducted, providing much new data of fundamental value to safe highway design and operation. Having had these contacts of long standing among State and local highway, motor vehicle, police, and traffic engineer officials, and others in responsible charge of official safety activities, the Bureau feels a natural responsibility and interest in furthering traffic safety research. At the same time, the special talents of the behavioral and medical scientists have been recognized by inclusion in cooperative research undertakings. One example of this cooperation is the interdisciplinary study of traffic accident causes for which the Bureau of Public Roads is supplying major financial assistance along with the United States Public Health Service and the Automotive Safety Foundation. Another is the joint effort with the Department of Health, Education, and Welfare in developing facts from their national health survey to define the dimensions of the national traffic accident toll.

If additional emphasis is to be projected for traffic safety research, the Bureau would welcome a continuation and extension of relations of the types cited. Past experience has proved that this joint work typically produces valuable returns.

A somewhat broader point has also been under consideration during the Bureau's work on the highway safety study. It is widely acknowledged that there is an outstanding need for coordination in traffic safety research. The disciplines applicable to highway safety that are found in a number of Federal agencies are quite diversified, yet each has a legitimate concern for research in its area.

Many other functions relating to traffic safety are widely scattered throughout the Federal structure. The same truth applies to an even greater extent among national associations of highway police, traffic court, motor vehicle, health, education, and other officials serving the public interest in States and local communities. Beyond these are the many quasi-public nonprofit, and public support organizations with significant and essential functions in the highway safety field.

Aside from the President's Committee for Traffic Safety which, by its own direction, serves almost exclusively the function of public support for official highway safety programs, there is no central agency for traffic safety research at the national level, except as it may exist within individual agencies and organizations. Various possibilities are being studied. One would entail the establishment of a separate national organization, which might be designated by some such title as the National Highway Safety Board. The board would be served by a limited staff of specialists and concern themselves with research guidance, channeling responsibility for specific projects to appropriate Government agencies or to other research facilities. The board might also undertake the task of safety research correlation, and move toward the objective of developing, defining, and working for adoption of standards for the major professional services and practices that contribute to highway safety. Similar functions might be performed on safety devices and equipment appurtenant to the highway and the vehicle.

Another possibility that may have merit would involve the establishment of an adequate central reference staff in the National Research Council. This distinguished organization might logically engage a share of its widely diversified efforts in the advancement and direction of traffic safety research efforts. The same general functions as were mentioned for the independent board might be suitable.

Still another variation would charge an existing governmental agency with responsibility for active coordination of traffic safety research on a nationwide basis.

The possible actions outlined and other prospects for an improved situation in this critical area will be evaluated by the Bureau upon completion of an administrative analysis of the many Federal responsibilities, activities, and programs pertaining to highway safety. This analysis is now underway as a phase of

the section 117, highway safety study. The exposition of the various proposals at this time is presented as an interim contribution from the Bureau's partially completed assignment on the highway safety study. A more precise evaluation of the research needs and the means for enhancing the values of traffic safety research will necessarily follow at a later date.

Dr. McFARLAND. Thank you very much.

Our last panelist is Mr. Merwyn Kraft. He is a man of wide experience in this field, and those of us who have worked with him on various research panels have always valued his counsel and advice very highly, indeed. He is Chairman of the Research Committee of the Advisory Council to the President's Committee on Traffic Safety and is currently coordinator of research at the Flight Safety Foundation in New York.

STATEMENT OF MERWYN A. KRAFT, COORDINATOR OF RESEARCH, FLIGHT SAFETY FOUNDATION, NEW YORK, N. Y.

Mr. KRAFT. Chairman Roberts and members of the committee, Mr. Moderator, members of the panel, and guests, this is not a part of my prepared statement, but for what help it may be to your committee, Chairman Roberts, it might be interesting to know that the Flight Safety Foundation has just completed a year-and-a-half study under contract with the CAA having to do with Federal regulation of medical qualifications in civil aviation, and included with that is a study of medical qualifications in motor carriers, merchant marine, and railroads.

As background, and to the extent that Federal regulation of medical qualifications may be pertinent, those reports may be helpful to your committee and should be available in time from the Civil Aeronautics Administration.

As one who has been engaged professionally for 20 years, either directly or indirectly, in transportation safety research, I strongly subscribe to the belief that a great deal of additional research in highway traffic is needed. There must be a continuing and expanded search for knowledge if there is to be growth and development of highway transportation so important to our national economy and in the public interest. Safety is a key element in such growth and development.

We talk about traffic-safety research. Are we really talking about the same thing or, as Dr. Lawrence R. Hafstad, vice president in charge of research staff, General Motors Corp., commented, is this "an area where the semantic noise level is high"? Webster defines "research" as "careful or critical examination in seeking facts or principles; diligent investigation." Dr. Hafstad takes a broader view with the definition: "Research is the effort of the mind to comprehend relationships which no one has previously known." I lean strongly toward this latter concept.

Review of literature generally considered applicable to traffic safety indicates that there has been a great deal of study, investigation, experimentation, and factgathering. While these efforts are essential to research, they oftentimes have failed to go far enough toward an understanding of interrelationships with the multitudinous facets of the problem. All too many have ended up as statistical comparisons of questionable validity and of even more questionable practical value.

One must be impressed by the subjects of articles, papers, and reports already existing in the traffic-safety field, and also by the recent listing of "some of the going or needed researches" in a consolidated report on traffic-safety research.

However, what disturbs me is that so mnay of these are attempts to get specific answers to almost isolated specific questions; few of them approach the problem with the objectives of learning more about the many interrelationships existing among a number of groups of factors and, for at least some of them, the nature of the relationship to traffic safety has not yet been clearly defined.

For example, one subject suggested is "How can vehicle deceleration be improved?" I am sure that automotive engineers can improve deceleration characteristics of motor vehicles, for they already have done so over the years, but is that a question which should be answered before we consider all of its ramifications, and particularly the full nature of the relationship between deceleration ability and accidents and injuries under a variety of driving circumstances—normal versus emergency, expressway versus city street, signalized versus nonsignalized intersection, et cetera.

What effect would this have on injury patterns of passengers? What other design changes might be necessary? Could tire characteristics remain unchanged?

To me, a much broader, more basic concept of traffic-safety research is needed. And while a realistic, practical approach is essential, we also must be visionary, looking to the day when scientific research may "launch a satellite" in traffic safety.

This subcommittee is concerned primarily with the responsibility of the Federal Government in the area of traffic-safety research. Here is the help needed from Federal sources, as I see it:

(1) Substantially greater funds, granted for longer periods of time (U. S. Bureau of Public Roads, National Institutes of Health, U. S. Public Health Service, and the military services already contribute some, but more is needed; and we need to have more long-range grants, not just year to year);

(2) Qualified, technical guidance with respect to—

(*a*) areas of safety;

(*b*) project design;

(*c*) planning and administration; and

(3) Assistance in the dissemination of research information.

One final word—the remark frequently is made that substantial advances in traffic safety could be made if only we applied all of what we already know. If this is true, even in part, then is there not a need for some comprehensive, intelligent research into the reasons therefor and into the means by which the unwillingness, inability, or just plain inertia can be overcome.

Thank you.

Dr. McFarland. Mr. Roberts, I think the summary statement made by Mr. Kraft is very much to the point. There must be continuing research, not from year to year, but on a long-term basis.

It has been very difficult for these experts to boil down their remarks to such a few words, but I think that all of the points have been brought out very successfully indeed.

Will it be possible to have all of these prepared statements as a part of the record of the conference?

Mr. ROBERTS. Yes, Doctor. Without objection, all of the prepared statements will be included in the record and also the Chair would like to introduce the statement of Dr. Kuhn, the ophthalmologist. I would like to state that she called me. She lost her husband about 3 days ago and was unable to be here and she asked that I give her best wishes to the panelists, to you, and to introduce the statement.

(The statement referred to follows:)

STATEMENT BY HEDWIG S. KUHN, M. D., HAMMOND, IND.

As an individual ophthalmologist faced for 30 years with visual safety and visual performance problems in industry, and as member of many medical groups likewise concerned, my interest and study of the very complicated challenges involved in traffic safety has been considerable. An automobile driver is actually just another worker operating powerful machine under circumstances that endanger both himself and others in the environment of his activity. This activity, contrary to his job experience in a steel mill, for instance, lacks enforced protective equipment, safety indoctrination, and competitive award contests. For no good reason whatsoever this operator—is on his own, feeling no pain and is characteristically, almost violently individualistic—the road is his—the other man is always wrong.

Focusing attention now on eye—all the elements of seeing—we face up to the same formula, to match a person's visual capacities to his visual job demands. A driver of a car must—

1. Have ability to see and recognize traffic patterns several hundred feet ahead, under all kinds of atmospheric conditions—snow, fog, rain, excessive glare, complete darkness;
2. To be able to read and interpret road signs;
3. To be clearly cognizant of traffic to the side and behind;
4. To see and interpret the dials on the dashboard—speed, gas, oil, temperature.

The visual skills making these difficult tasks possible are multiple. Basically they include:

1. Acuity of vision (sharpness) for infinity—designated in most States now as not less than 20/40 in the better eye—(ability to see at 20 feet what one should see at 40 feet). This is a rockbottom minimum and yet there are thousands of people driving with vision 20/200 in both eyes (ability to see at 20 feet what should be seen at 200 feet). These people walk through the doors of our clinic day in and day out—and we cannot report them. We can only plead, usually to no avail.
2. Binocular vision, i. e., no diplopia (double vision).
3. Color appreciation theoretically is needed to recognize stop-and-go signs but it has been learned that the red-green blind person can interpret what he does see as stop-and-go—and lack of color appreciation is not important.
4. Muscle balance normal especially for distance—excessive divergence or convergence of eyes produces fatigue (true muscle fatigue) and fuzziness of image.
5. Normal form fields—ability to note and recognize objects, stationery or moving, to either side of one. This must be either on the road when moving or at intersections and railroad crossings. There is rapidly accumulating evidence that this ability is much more important than hitherto recognized.
6. Various eye diseases and conditions prevent proper performance.
   (*a*) Infections of eyelids which produce light sensitiveness.
   (*b*) Insufficient dark adaption and glare resistance.
   (*c*) Use of drugs that produce a blur or slow visual response.

Now with reference to research in the area of visual skills needed for driving—all of us working in this field are painfully aware that of all the physical requirements (other than drivers with actual disease)—component interlocking elements of seeing (in the broad sense) rank first, and yet there are many poorly defined and poorly understood factors.

For instance:

1. We know judgment and experience are adequately compensated for in the one-eyed driver. Where do we draw the line? ICC has one criterion, are there others?

2. How can we evaluate exactly the part that form fields play and how can we introduce the tests for driver's licenses that give us the necessary information?

3. Already much has been done in the area of colors of signs and types of illumination that increase visibility. Important to seeing—even the perfect eye cannot see in pitch darkness—this is a field outside of visual skills but one must understand all the functions of the eye or plans will go far afield.

4. One fact in particular has challenged research groups for years and remains unsolved. We know that there is no such thing as eyestrain in the sense that we strain a heart or muscle. There is no such thing as eye fatigue per se, as measured and studied by all the techniques of fatigue of muscles, nerves, etc. There is ocular discomfort from slight to severe, that, we all know. But no one knows exactly what the elements producing ocular discomfort are. What produces a headache, red eyes, or watery eyes when excessive visual demands are made on certain people?

As far as I know, the Armed Forces NRC Vision Committee's project on vision and driving is most exhaustive and comprehensive. It is strictly limited to vision per se—and does not spread itself through consideration of related factors such as improving environment, evaluation of judgment, attentiveness, etc. While having no idea of their budget or budget problems, I do know we are carrying out a project for this committee in Indiana without a grant, without money, but with interest and dedication of Indiana State troopers, Purdue University, and some medical people. Traffic safety committees are being set up in each State by the State medical societies—they need leadership, instruction, and guidance to avoid increasing the already existing duplication and overlapping. Our new Indiana law requiring eye examinations for driver's licenses was the result of interested medical folks.

Above all things needed is a central clearinghouse of work done and work in progress.

Mr. ROBERTS. I think, gentlemen, that this has been one of the best sessions as far as this subcommittee is concerned and, as you know, we have held many hearings and have interviewed many witnesses and have heard a great deal of testimony on this important subject.

It occurs to me that a great deal of good has been accomplished this morning.

I am wondering, Doctor, if we might find out how many of the gentlemen on the panel could come back this afternoon, say, at 2:30, provided I can get permission from the Speaker to continue the hearing.

Could I get a show of hands on that?

(Show of hands.)

Mr. ROBERTS. That looks like a pretty substantial representation and if we can have that arrangement that we will meet back for the discussion this afternoon at 2:30, I think that will allow ample time for lunch and give me time to get to the floor and see if I can work out the arrangements.

In case something happens that we do not get to meet, I certainly want to thank you on behalf of the subcommittee.

I feel that a great deal of good has been accomplished and I am hoping that we will get to have this further discussion this afternoon.

I thank all who participated in it. Especially I thank Dr. McFarland for a very fine job.

The subcommittee will be adjourned until 2:30 this afternoon.

(Whereupon, at 12:30 p. m., the committee adjourned until 2:30 p. m. this same day.)

AFTERNOON SESSION

Mr. ROBERTS. The subcommittee will come to order.

Dr. McFarland, will you summarize briefly for us the discussion by the various panelists this morning?

Dr. MCFARLAND. I will not take the time to review or to summarize what was said in detail this morning. It will be possible after all of the reports are in, however, to make a summary of what was said this morning and of the different statements that have been filed.

We might use the time that remains for a discussion of some of the more important points which might be of use to the committee. I think it was obvious this morning that one of the needs in this field is to set up carefully controlled experiments. We must use precise, basic, scientific methods and disciplines in setting up experimental designs and procedures that will be directly concerned with the different areas under investigation.

Dr. Goddard first presented the overall problem and recent data from the National Health Survey on all types of accidents.

The first research area had to do with the use of mathematical statistical methods in accident studies and the exploration of the characteristics of drivers from the point of view of psychology and psychiatry by Dr. Dunlop and Dr. Kelley.

Then we heard from Dr. Gaskell and from Dr. Bobbitt about the role of the psychiatrist and the clinical psychologist, and the importance of studying driver attitudes, and trying to set up procedures or methods that might change the drivers' attitudes as well as his behavior

Later we heard from Dr. Woodward and Dr. Brandaleone. One of the important points concerned the setting up of procedures to obtain more evidence on who should or should not drive, having certain physical defects. The problem relates especially to those with illnesses, such as epilepsy, diabetes, heart disease, and other advanced conditions. We should carry out additional experiments that will give us more information about how to limit such patients while they are actively ill and, for example, may lose consciousness from their disease while driving. The newspapers are filled with evidence of this sort, and yet positive correlations between accidents and physical defects have not as yet been reported in carefully controlled studies.

The point of view of the National Education Association was presented by Mr. Abercrombie on the importance of driver training. Here, again, we would like to see controlled studies of drivers with and without instruction and training, to determine the benefits. There is evidence that there are benefits, but we don't know how long they last.

Some of the studies indicate that after 5 years the effects wear off. But during the initial driving period there is evidence that training appears to be very important, especially for young persons.

Then we heard Mr. Johnson, of the National Safety Council, outline some of the programs and policies in regard to large-scale research. That was followed by a series of witnesses from the point of view of engineering. Mr. Wright outlined some of the essential areas in which he feels research would be important and the role of university laboratories in carrying out such studies.

Mr. Milliken emphasized the quantitative measurement of the driver through the use of electronic means, and of setting up mathematical models, which is a problem dear to the heart of Dr. Dunlap and his group. They have had several conferences in the field of mathematical models for research on accidents.

We will send you one of the reports, based on a conference of 30 of the ablest mathematicians in the country.

Then John Moore emphasized the necessity for a broad approach to the problem of highway safety and related subjects. John Stapp brought out the significance of research on restraining devices, and the necessity of knowing the thresholds of tolerance for the body, particularly the head. Such data would be useful data for the engineer. How can the engineer design to prevent something if he does not know the parameters with which he is dealing?

I will never forget observing one of Colonel Stapp's colleagues, a young physician at Holloman Air Force Base, who was propelled by three rockets about twice the distance of this room in an experiment to demonstrate the value of a seat belt. He was stopped within a distance of about 3 inches. The speed attained would resemble a person driving an automobile at about 50 miles an hour and being stopped as if hitting a brick wall. The young physician experienced about 30 g.'s without ill effects. After a few minutes he got up, walked about, and apparently suffered no ill effects, except a few bruises. He was leaning forward during the run to prevent pivoting at the waist. The restraining device or lap belt was adequate to prevent serious injury.

Then we heard from Mr. Baker and Mr. Mathewson. Mr. Baker outlined the results of studies in the Traffic Research Institute at Northwestern University, the current projects in which they are engaged, and further basic studies which are needed.

Mr. Mathewson also pointed up the need for additional basic research and emphasized the importance of a driver simulator, which Mr. Milliken has previously mentioned.

There is great interest now in the development of a driver simulator. This is a very costly and time-consuming project, but from the data we have on flight simulators for aircraft, it would obviously be of value. It would be of great use in training younger people, of setting up limitations and cutoff points for older drivers, and for those with certain physical disabilities or diseases. Also it would have obvious significance in evaluating training programs and could be used to advantage with younger people as well as older people. It would provide us with a research tool which we do not have at the present time.

Mr. Holmes pointed up the significance of research from his point of view in the Bureau of Public Roads. I agree with him that more research is needed in regard to the human problems in the construction of highways. I think that operational research and carefully controlled studies in regard to getting on and off highways, for example, have not as yet been studied to the best advantage from the point of view of introducing the human factor. I know that you are interested in this area, Mr. Holmes, and would like to formulate more precise investigations. You might call it human engineering in relation to highway design. Certainly this is an important field.

Mr. Kraft spoke of the importance of research in terms of delineating the unknown factors, and the new knowledge that might

be revealed through research. At present, we are not fully aware of the nature of the problems, and this, of course, is fundamental in all scientific investigations. It is not the elaboration of what is known. It is necessary to try to take a new look or a new approach to the old problems. By using a combination of different disciplines, and, with a free mind, explore areas which, at present, are not understood.

Mr. Kraft also made the very important point that research cannot be fertile or fruitful if carried out on the basis of hand-to-mouth financing. It must be sponsored through a period of time. If we are to use this "slave labor" in the university research laboratories that Mr. Mathewson was talking about, the scientists must have some assurance of continuity.

These are a few of the highlights of the various witnesses. I think it would be well to throw the meeting open for discussion now on the part of the panelists. They might be able to focus more precisely the areas and the type of work that might be eventually sponsored by the Government.

Mr. Roberts, that completes a brief summary of the morning's discussion. We would be greatly interested in hearing of any questions that you might wish to put to any of the panelists.

If there is any way in which we could help get the information which you need or would like to have, we are certainly here with that purpose in mind.

Mr. ROBERTS. Thank you, Doctor. I think there will be some other members of my subcommittee present in a few minutes.

I think if you would like to pick out one question that has been mentioned this morning and have sort of a general discussion on that, it might be helpful. I think it would give all the members of the panel a chance to make a contribution. What I have in mind is that it seems to me this whole thing points up the fact that there is definitely a need for Federal funds to explore this field of research.

I am wondering if you would simply take that question and let us get some ideas as to where they think those funds should go, and what department of the Government should be in charge of those funds, and some general discussion along that line.

Dr. MCFARLAND. I think there is great interest in that question. It is the sort of question which we hoped would be raised. I will now throw the meeting open to any statements which the panelists may wish to make in regard to it.

Dr. Kelly?

Dr. KELLY. Mr. Chairman, before discussing the question of the most appropirate Government agency to dispense the funds, or to administer research funds in this area, I think we might well note certain other characteristics of these funds if they are to be attractive to researchers and to yield maximal results in research productivity.

First, I would call attention to the fact that there are never enough scientists to go around, and, in general, the laws of economics are such that good researchers tend to work on the kinds of problems for which good money is available.

In a researcher's mind, good money means not only adequate financing of his research plan, but ability to make long-term plans with respect to his research program.

It is unthinkable to try to assemble and maintain a good staff if one is on a year-to-year basis of support with the result that the

researcher has to spend his time worrying about how to pay his staff's salary. At the very minimum, and regardless of the agency which administers the fund, I would hope we could think of long-term projects, conducted preferably by groups of researchers operating in settings where they wouldn't have to spell out in advance everything they would have to do. In other words, where the betting would be more on the competency of people, rather than oriented toward contracts that require delivering certain findings on a specified date.

Dr. McFARLAND. I think there is also the point to be made that research flourishes in the universities where the scientists doing the work feel that they are making a new and basic contribution to knowledge, independent of its practical applications.

I feel very strongly that if the research is properly designed and planned, it can be a double-edged sword; that is, the results can be important in both pure and applied fields of science. The knowledge and information that is brought forward can stand on its own feet, and, at the same time, have broad, practical applications for highway safety. I would like to give two examples.

For instance, at the present time, we do not know a great deal about the thresholds for head injury, but from the work of John Stapp and others we are beginning to obtain such information. It is just as important to know about thresholds of head injury for an automobile accident as it is for any other injury. Surgeons are greatly interested in a more precise delineation of this problem. One might get many surgical and engineering groups to combine with university research laboratories to work on such a problem. Basic information would be obtained for the automobile engineers in trying to design equipment so that such injuries would not occur and also for surgeons in a better understanding of the problems.

Another example is the problem we have been interested in at Harvard, namely the field of night vision. It is an important one in the field of experimental psychology and gerontology, or aging, as well as highway safety. Let us briefly examine the problems involved.

Based on data from the National Research Council, it is known that two-thirds of the fatal accidents occur at night or at low levels of illumination. Furthermore we know that as you grow older, you need more light. Your eyes are less sensitive at low levels of illumination. We have worked out quantitative methods to study dark adaptation and we have found a very high correlation between age and seeing at low levels of illumination. The results of this study have important implications for the automobile designer and engineer, for instance in regard to the question of the tinted windshield. In the highest density or tinting of the glass is put at the eye-level height, the windshield itself would cut out 30 percent of the transmission of light. But if the high density of the tinted windshield is not put at eye-level height, it can be used without necessarily jeopardizing the safety of the driver.

Also there are implications from the above studies for the design of highways and the lighting of highways. If it is true that two-thirds of the accidents occur at night or low levels of illumination, then it is obvious that lighting is important. Thus, if you take such a problem and delineate its implications, one can create interest in the university laboratories concerning the basic research involved, as well as the practical implications.

I know there are others who have ideas on the question of setting up long-term projects on a broad basis.

Could we have some comments?

Dr. DUNLAP. I would like to comment on this question. It seems to me that the question is unanswerable until we first set down some criteria against which to answer it. For example, here are some of the things that we need to know before we can talk about funds: What are the purposes of these funds? Are they going to be used for long-term studies?

Are they going to be used for short-term studies? Or for a combination of such studies? What classes of studies and problems should we be interested in?

I will raise another question about these funds which needs to be answered. Who should be served by these funds? Should they be devoted only to problems that are behavioral studies on man? Should they be spent only on problems which would be of use to industry? Or on problems which would be only of use to the Air Force, Navy, and Army, or even to the Bureau of Public Roads? What are the relative amounts? What are the criteria that we want to set up here, what amounts, percentages, or other values do we want to put on them?

We come to other problems in regard to funds, in trying to blueprint them. Who should do it? Should this be done by Government agencies? Are you going to preclude from these Government agencies going to whoever you designate to get the money? Should it be only for universities? Or should it go to types of institutions? Or, God forbid, should it go to a private company, such as I represent? Or what limitations should we put on all or any of these groups?

We need to know whether our concern is with laboratory or field studies. Field studies are inordinately costly, yet there are certain ones that have to be done. On the other hand, simulators often run $2 million or $3 million apiece.

Is this work to be limited to applied studies? Or shall we do only theoretical studies?

When this blueprinting has been done, we will be in a position to talk about amounts. One can't say whether a dollar or a million dollars or a hundred million dollars is required until these needs are defined. Maybe $5,000 is enough, but it may be that $5 million is necessary to solve a given problem, but you can't tell until the problems are blueprinted as to details. This is the way I would approach cost estimates.

Thus, the question, as phrased, as to amounts is very difficult to answer.

Dr. MCFARLAND. I think we should be practical and reasonable in working out goals for our research. Maybe we would wish to start out modestly and hope to develop more comprehensive programs after a year or two of practical experience.

I now wish to call on Ted Wright. He has had wide experience in the field of Government agencies and research. I think his remarks would be really relevant.

Dr. WRIGHT. Thank you, Ross.

I don't think we want another new Government agency involved in this. I think the agencies we now have, Public Health, Public

Roads, and so forth, are very competent and know the fields that they would like to support if they had more to spend. I think you probably do need, as was suggested by the last speaker, a coordinating group. I don't know what that should be, possibly the National Research Council.

But one that has the overall picture, and which should then recommend to the Congress increases in funds in existing agencies that are now interested in automobile safety for augmentation of the funds that they have asked for or that they might ask for.

I think that setting up another special agency which would immediately lose the benefit of people in Public Roads and Public Health who already know their job well would be a great mistake.

Also, a new agency would have a tendency to mushroom. They might get into matters of legislative recommendations of a restrictive nature that would not be good. Even though I was the Administrator of Civil Aeronautics, and I think in aviation that such organization was necessary, throughout the growth of aviation from a very dangerous period to a very good period now, and was and is a good thing, I would be concerned to see such an agency set up for automobile safety.

Mr. KRAFT. Our research committee has been interested in finding sources of more funds for traffic-safety research. A few years ago we were looking at the possible availability of such funds from the Bureau of Public Roads, which has some authority for research. We found that their interpretation of the uses to which those funds could be put would not permit them to channel research money into studies of human behavior.

We had hoped that the Federal-Aid Highway Act would include some authorization to permit funds available under that act to be used for research on human behavior rather than be restricted to research only on construction and design, or factors of an engineering character. This was not included, however.

Perhaps a little background from E. H. Holmes, of BPR, on what can be done now with funds designated as research funds would be helpful in visualizing what needs to be done to get moneys for the kind of research about which we are talking today.

Dr. MCFARLAND. Mr. Holmes?

Mr. HOLMES. I might, in answer to that, say that under the Federal-aid highway legislation we do have specific authority to include in research work, research in the field of safety.

We have had, however, some limitations on the total funds that are available to us for all administrative purposes. Over the years, it has been our interpretation that for this reason we should limit our work in the field of safety research to that pretty directly related to the highway and to the vehicle.

In the 1956 Federal-Aid Highway Act, however, we were instructed to undertake a broad study of highway safety, and to report to the Congress our views as a result of that study on the Federal interest in the safety problem. We were given an authorization which, in effect, is a limitation of $200,000, to complete that particular study. We felt that as a result of that action, we had no limitation, at least, that would preclude our exploring the field of human behavior and its relation to highway safety, particularly as it, in turn, is related to the highway and vehicle.

Consequently, we joined with the Public Health Service and the Automotive Safety Foundation, as I mentioned this morning, in initiating a pilot study at Northwestern University, which involves accident studies by a team composed of an engineer, a doctor, and, I believe, a social scientist. I think that is the right term, Stan?

Mr. BAKER. That is right.

Mr. HOLMES. We are using this pilot study of the team method to investigate accidents as a means of determining whether or not such an approach will yield productive results. If so, we will recommend that this type of research be continued.

I think we would want to recommend that there be Federal aid in the financing of such research, whether it came through the Federal highway funds or some other source of Federal funds.

That, however, is such a limited amount of money, that I think we can say still that we have no real money available to conduct intensive or extensive research in this field of highway safety.

If I might go a little beyond your question, we believe that in our highway field, we do have a responsibility for research in the effect of the highway, and, to a considerable extent, of the vehicle on traffic accidents; and would want to continue in that field to the maximum extent we can.

I think under the law, which gives us authority to use 3.75 percent of the Federal authorization for purposes of administration, that, given the go-ahead by the Budget Bureau, we could use whatever of those funds that would be necessary in this field. But we would feel that we would need some pretty direct guidance in that direction before we could use a disproportionate amount for that purpose.

But in any event, to the extent that we can work in that field, we should want to do it only in cooperation and coordination with any other Federal agencies that have a proper interest in the field, and who also may have opportunity to work in it.

It is in that area that I feel we would be greatly helped by some central coordinating agency. I suggested the National Research Council as one possibility this morning, again with the idea that competition for competent people is pretty intense, and, if we can lodge anything like this in a going concern, we are a whole lot better off.

Mr. KRAFT. I have one more point that I thought worth while, having to do with the concept of long-range projects. Does not this have to be more of a philosophy than an actual, spelled-out legislative act in terms of how long range these projects are? I am thinking of the projects sponsored by the Armed Forces Epidemiological Board with which we are associated.

While they give grants on an annual basis, they actually frown upon short-term proposals. Unless you come in with a proposal that has long-range prospects, it generally is not too well accepted. Their basic philosophy is one of having investigations that will run for possibly 3 years, at a minimum.

I believe most studies now being sponsored by the commission on which we serve have been in being for periods up to 5 or 6 years.

Mr. JOHNSON. I have a feeling, as you are commenting on these administrative matters, that we are not going to answer the questions asked, except as some things are changed at the Federal level.

A year ago we pointed out, if you will recall, Congressman, to your committee, that there is almost a complete lack of coordination at the

Federal level in various activities which affect the highways. I don't say this facetiously. There are days when we sit in our office in Chicago, and we are naively assuming that because all of you people are located here in Washington, you are pretty well coordinated. But there are days when a phone rings, and we believe you are coordinating yourselves through our offices. We don't object to that, but we think it is a little strange. Many times people from Washington find out what is going on down here by coming through and talking with us.

It is utterly fantastic to believe that you are going to get rational research policies or rational policies on other aspects of the highway or accident problem unless there is a device set up for overall coordination at the Federal level.

We have a major campaign on to get coordination at the State level. The title of the article that outlines the things that we suggest is "Are chief executives delegating death?" Some people are taking this thing rather seriously. Until and unless there is coordination at the Federal level, these very good questions, which deserve thoughtful answers, long-range policies, and so forth, are not going to be answered, certainly not by a panel such as this.

With all respect to a congressional committee, I don't believe that the staff work that would have to go into research plans or a determination of a sound agency can be done by legislative means. I think we need a central place in the executive branch where coordination is effective.

The CHAIRMAN. I would like to have some opinions on this idea. I have felt, too, that there is certainly a lack of coordination in this entire picture. In fact, that was one reason, I think, that Congress approved the resolution to create this congressional committee. It has been suggested on the Senate side that we set up a special joint committee on traffic safety. I talked to a Senator that has that idea. He has been out of the country some, and I have not seen him since he returned. I am wondering if such a committee could more effectively coordinate the legislative aspects of this problem on the idea that Mr. Holmes broached this morning, that in the event research funds are supplied by the Congress, we would probably need to follow the precedent of a national advisory council as we do under the 1956 act. In working out the award of those funds, I believe that the Secretary of Health, Education, and Welfare works with an advisory council. I believe they have quarterly meetings or they can be called, I think, at almost any time. Maybe I am getting into too many questions, but I am wondering what the feeling of this panel would be about a joint congressional committee, House and Senate.

Mr. JOHNSON. We have had some discussions with staff people on the Senate side. I think under proper terms and conditions, it would probably be very helpful. I might say on the record that we believe that, if the joint committee followed the same policy as your committee follows, with careful appraisal and investigation before the acts, it might be constructive. It might also be constructive if there were adequate staff appropriations.

To me, it defies belief that you or the Senators can form opinions on some of these questions that have been raised here today without adequate staff work, and very exhaustive staff work, to back it up. I think if there is a joint committee, you would have to face the fact that there should be a substantial appropriation for staff work.

Mr. HOLMES. If I might, I would like to introduce one additional thought. We felt rather pleased in the study we were able to set up at Northwestern. We were able to attract not only Federal funds from another agency for that study, but also funds from the automotive industry, through the Automotive Safety Foundation, which is contributing rather substantially to the project.

I feel in this whole subject of a safety research, that there is a great responsibility outside of the Federal Government. There are funds available and perhaps there should be more funds available through industrial and other sources that should be directed to this problem.

Since I believe that the Federal Government could do a great deal toward stimulating the bringing in of additional funds from outside, I would hope that we don't look on this problem as one that must be financed wholly or even primarily with Federal funds.

Mr. ROBERTS. Isn't it true, Mr. Holmes, that as a rule, where in the past we have provided research grants, that they usually stimulate other funds to the extent of a ratio of about 6 or 7 to 1? I think that has been our experience.

Mr. HOLMES. I don't believe I could attest to the ratio, but I am sure that is a fact.

Mr. ROBERTS. We had testimony, I remember, on the 1956 act, several people who testified that that has been their experience. Where we had made these funds available, industry and other groups have come in, and the ratio usually runs about 6 outside dollars to 1 Federal dollar. I think that is in the testimony on that act.

Mr. HOLMES. One research project with which I am familiar, the AASHO test road in Illinois, mentioned by Dr. Dunlap, is a $22 million job for highway design purposes. There is, I think, about $6 million of Federal funds involved in that amount; the rest comes from State and industrial sources.

Dr. MCFARLAND. I believe that the ratio of 1 Federal dollar to 7 outside would be difficult for universities. The foundations have used matching funds, and the health service, but it has usually been on a 50–50 basis. I believe that it is helpful to get both parties involved. I think the 7-to-1 ratio might be difficult for the universities and research institutes.

But the principle is sound.

There are two people who have been wanting to speak.

Mr. MOORE. First we have the precedent that this was a multidisciplined field, that it did not fall under the domination of any single discipline, and the minute it got underneath those disciplines, it would not accomplish anything more than additional segmental research.

When atomic energy was born, it did not rightfully belong to the physicist, the engineer, or the mathematician. It was a "breakthrough" of knowledge. We have been proposing that what we also need is a "breakthrough" in knowledge, and perhaps the instrument of coordination or centralized direction would have to be a breakaway from the existing practices of segmentally inclined people who cannot but be oriented in the discripline they have been reared in.

This was the thought that the dean of engineering at Cornell used in trying to analyze our own research program in seeking to find a place for it in our academic family.

Secondly, we have the precedent of the fact that America dominates the aircraft industry world; and, to a large degree, that domination

has come from the support of aeronautical research supplied through the National Advisory Committee for Aeronautics, through which industry had access to Government facilities where it could not, with its own monetary limitation, supply its own resources.

Then we have the precedents of the National Institutes of Health, with fund-granting capacity that NACA does not, in general, possess. Here you have three precedents of existing agencies that have faced up to the problem of a method of man's transportation or a new breakthrough of knowledge, combining many disciplines, and have found a way to coordinate and to preplan both short and long-range types of funding in this area.

I would certainly hope that none of us here would expect all funds of this nature to come from Government sources, because there are people involved here who have product improvements at stake. Certainly we would hope that they would, by their contribution, express their interest in the utilization of factual and scientifically sound answers obtained from such an approach.

All of this knowledge that we are talking about acquiring, unless it is put to use, is not going to do us much good.

Dr. WOODWARD. Gentlemen, it appears to me that perhaps some of our thinking could be improved or clarified a little bit if we could get all of you gentlemen to think like the doctors do. We sort of divide our thinking into two groups. One is the clinical approach and the other is the research approach. I have been exposed to both ideas of thinking, all of my adult life working in a teaching hospital and medical school. But here I am primarily interested in the clinical approach, and you will pardon me if I discuss that, first.

That, to us, is the first and most important part of the problem. As the chairman for many years of the department of otolaryngology at the University of Virginia, we were responsible for the repair of the faces and jaws of all of those who were so injured in automobiles.

This took us many hours of the day, and frequently all night long on weekends. Sometimes the next morning on Sunday, we were still working. If I wasn't there, at least my staff was. We observed and studied these injuries over a period of years, and reached certain conclusions as to their causation. Our conclusions have been partially substantiated by our facts and figures, also by the figures of John Moore, of Cornell, and others over the country. We feel that there is something we can do now to improve the situation from a clinical and engineering standpoint.

Sometimes you will find a man in the emergency room, dead on arrival, and his wife critically injured, perhaps small children are on the back seat of the car uninjured.

They are brought in at 1 o'clock in the morning as strangers. The father is dead because of an impact against the steering post, and the mother is injured because of an impact against the unprotected windshield and dashboard.

Another man is brought in critically injured. But the man who was in the opposite car during the collision was less severely injured. The next morning, when he had regained consciousness, I went in and asked, "Do you know what you did last night?" and he said, "No, I don't recall. I had been drinking a little bit. But what happened to my Chevrolet? Was it all right?"

He didn't care about the man who had been killed. I recently saw a child sitting on his mother's lap, and on sudden impact the child pitched forward and the door handle punched out the right eye. Well, we don't have to have a projecting door handle there. Why not a flush door handle?

Those are examples of the clinical aspects that daily confront us. That is why we talk a little bitterly about poor automobile design. We have reached certain conclusions which we think are true. But we cannot prove them by percentage points, but we do know from observations that about 50 percent of the fatal accidents involve a drinking driver. One-third by speed and many from poor automobile design.

If that is true, why not do something about the drinking driver and these other factors now? Most States have laws which pretty well exonerate a man who has a blood-alcohol level below 0.5 percent, and we have no fault to find with that.

We also have laws to punish a man with a blood-alcohol level of 0.15 percent or higher. But we do find fault with the judge or jury that lets him off with an admonition and a slap on a wrist and a minimum $100 fine for committing murder on the highways. We think there that the punishment should be severe.

We think a drunkometer test should be mandatory, that the results should be accepted as evidence, and that we should have laws to punish those whose blood-alcohol level is between 0.05 and 0.15 percent. These laws should be adequate for the purpose of determining drinking and driving.

We are not concerned with whether the individual has reached the level of, say, 0.10 percent on a fasting stomach or an empty stomach. We are not interested whether he is an experienced drinker or a neophyte with his first drink. We are not interested in whether he drank beer, whisky, 86 proof, or 100 proof. Those things do not concern us. We are not interested whether it is an ascending or descending curve of intoxication. We are only interested in the fact that this man has a blood level at a point where he is incapable of operating an automobile. And, because of that, if he is involved in an accident, he should be punished severely.

We don't care whether he is dependent on the car for a living or not. That doesn't make any difference. For the reckless and speeding driver, we have to have tough laws too.

Recently I was trout fishing in the mountains, and as I was going up a hill, a big Buick zoomed by me, crossed a double line, and went over the crest of a hill on the left-hand side. It made me shudder. I knew something would happen at the top of that hill. However, it didn't, and she went on. But if I could catch someone like that, and had the authority, I would fine her $1,000, and suspend her driving permit for a year so she wouldn't do it again.

We have to get tough and we have to do it now. So much for the alcohol and the speed and reckless driving.

If a third of our fatal accidents involve speed, we should do something about that, too. The question of automobile design is a thing that rankles considerably under the skins of the doctors who work with these injured people, for we see them every day and every night. And we know that automobiles can be designed that will be safer, much safer, than anything we have today, and it must be done. Pro-

tective equipment, as restraining belts, must be a part of the standard equipment of every car.

As far as the medical aspect of this problem is concerned, it is not a very large one. Perhaps 3 to 5 percent of deaths and injuries are due to some medical condition. We are actively studying that.

We have one pamphlet which you will see advising the patient himself, and called Am I fit to drive? We have completed another book for the first time in medical history, which will serve as a guide to a physician, in his determination of a patient's physical fitness to drive. This will be an authoritative reference for him. If a patient comes in who has diabetes, and who is taking insulin, for instance, certain recommendations are made concerning this problem.

His physician has no police authority, but he can talk to his patient and give him a pamphlet for his guidance. We are in the process of preparing a third book, which would be a guide to the examining traffic officer, in setting up physical standards of who should and should not drive a commercial vehicle, a private car, or a bus or a passenger-carrying vehicle.

We think all those things will help. We have recommended that traffic consultation committees be set up, staffed by doctors and psychologists, who will examine repeat offenders and those referred to it by the judge and by other physicians.

We advocate, of course, driver-training schools. We must have them not only for the youngsters in school but for the repeat offenders and others, who should take these courses before they are permitted to drive a car again as the suspension or revocation of their licenses.

That, more or less, points up the things from a clinical point of view. Remember that if the doctors had waited until all the facts were available before they started the control of smallpox, typhoid, diphtheria, polio, and other epidemic diseases, the control of them would have been long delayed. The effort was made before all the answers to these things were known.

We have enough data right now to do something about stopping the slaughter on the highways, by using the facts and the figures we now have. We know they are not complete, but we can use them, and accomplish a lot today, by proper legislation in the States, or in the Federal Government.

The other side of the picture is the research side, and I am cognizant of the importance of basic and applied research, which is very important but will take many years to bear fruit.

Several years ago, I proposed that a national foundation be set up which would serve as a clearinghouse for all of the mass of data that concerns this problem. It would act as a repository of knowledge, or library. Since that time, the National Safety Council has taken over many of these duties, and they are now acting as a library. If you wish data on a certain subject, they will send it to you, or you could go and study the material there. We also need some type of clearinghouse so that if I have a problem at the University of Virginia that I would like to do, which involved research, I would then propose it to a certain group, perhaps a national advisory council, and they would take the proposal and say "Is it worth while?" or "Somebody is doing that over here. So let's don't duplicate the work. Maybe there is something else you could do."

They could point to the need for research, and say who is best suited to do it. This service could be administered under an existing Federal agency, such as the Department of Health, Education, and Welfare. If research can't be underwritten by private funds or foundations, I think the Government should certainly step in and see that it is underwritten.

If we approach this problem from two aspects, one clinical and the other, basic research, we will get the final answers. But for the emergency that exists today, let's first apply the clinical approach.

Dr. McFARLAND. Thank you.

Mr. MATHEWSON. Mr. Chairman, and gentlemen, I agree with what appears to be the consensus that there is no need to establish a new Federal agency to administer any such fund as might be brought about by the Congress.

I think, too, there are agencies now in existence that have the competence to administer any such fund that might be created on a continuing basis. I agree with Commissioner Holmes that the National Research Council is a very logical place. One of the reasons I say that is the following: I think it would be a grave mistake if we create another group in any existing agency or any new agency, with a proprietary interest that the only thing we are interested in now is the human being.

This morning's discussion, I think, from this panel, adequately portrayed the necessity for systems types studies; that we can't study man in a vacuum or unto himself, but we must study him as a part of the system.

It was brought out repeatedly that this is a transportation system we are discussing.

It consists of a roadway with its total environment of signals, signs, markings, other vehicles, landscape, trees, houses, everything we could conceive of. It also consists of the vehicles that the manufacturers make and give to us to move about.

It consists of the supply lines for these things. There are great conflicts. Anyone who thinks that the solutions can come about through a simple study of any one element to the exclusion of others—well, it just isn't in the cards.

I would say that the National Research Council, which has divisions in the physical sciences and divisions in the life sciences is in an admirable position to administer this sort of fund that we are thinking and talking about. Failing this, in the event that the Government or the Congress can't give it to the National Research Council, for some reason unknown to me, there is still another possibility, and this would be through the National Science Foundation, which does have Government recognition.

Here, however, I think it would be necessary to spell out a little bit to the National Science Foundation, that there is more than basic research here. We get into semantics and arguments over words as to which is basic research and which is applied research. Gentlemen, we have both in this case, and the one must be the handmaiden to the other. Neither must be excluded from our considerations.

Thank you very much.

Dr. McFARLAND. Is there someone who has not spoken?

Dr. KELLY. I will speak briefly since time is short. I, too, think of the National Research Council as a possible group or organization to administer an advisory council, but I am very much concerned with the fact that it does not include the social sciences, and hence its specialists would not be concerned with the type of problems of which Dr. Woodward was speaking; for example, "Why don't we do something with the knowledge we now have? Why are we unwilling to accept stiff penalties for reckless driving or drunken driving?" Such questions fall in the bailiwick of the social sciences: sociology, social psychology, political science, public relations, and disciplines, which, to my knowledge, the National Research Council doesn't represent.

While on my feet, I, too, would speak against creating a new agency. I do think that we should remind ourselves that the Office of Education also have some research funds. These might very well be supplemented. The important thing is not to have a new agency, but to get some earmarked funds for this sort of work which must be done.

I do not share Dr. Woodward's feeling that we have to blueprint all of this ahead of time. I think if we get adequate funds, we will attract talent. A great many scientists are greatly concerned with the problem, but funds for this kind of research are not available.

A few years ago there was a great deal of want for research in mental deficiency. The Public Health Service could not develop a program in this field until research funds were appropriated. The same thing was true with the tranquilizing drugs. New and special grants were granted and new programs set up in the NIMH.

I think we ought to have special and expanded programs for all of the agencies now appropriately concerned with the problem of traffic safety and then somehow coordinate all of the efforts.

Mr. JOHNSON. I would still feel that you have to have the additional element of coordination. If my information is correct, part of the pitifully small amount appropriated for research at the present time was cut—held back—from the authorized expenditures of the Department of Health, Education, and Welfare by the Bureau of the Budget, which raises a question in my mind as to who is steering.

Dr. MCFARLAND. Do you have any questions, Mr. Chairman?

Mr. ROBERTS. Do you have any questions?

Mr. LOSER. I just have one question. Did you say, Dr. Woodward, that 50 percent of the highway accidents are attributable to alcohol?

Dr. WOODWARD. Yes.

Mr. BAKER. You would have to amend that by saying 50 percent of the fatal accidents.

Dr. WOODWARD. I said the deaths.

Dr. MCFARLAND. In some studies the percentage runs even higher. Where carefully controlled studies have been made, including autopsies, the relationship between alcohol and auto fatalities has proved to be a very significant finding.

Mr. LOSER. The reason I asked the question is because I thought the doctor referred to traffic accidents. I was a public prosecutor for many years, and that was not my experience.

Mr. ROBERTS. Does the gentleman from Pennsylvania have any questions?

Mr. BUSH. I appreciate the fact that these gentlemen have taken time out of their busy life to spend the day with us, to give us infor-

mation, and to try to brief us as much as they possibly can on the benefit research can be to us in dealing with a subject that is so important to humanity today.

The thing you are advocating, and I agree with all of it, will take time, time for all of this research.

Don't you have some suggestions that we could benefit from more rapidly?

Mr. MILLIKEN. I think past experience has shown that by the methods currently in use, we have not gotten the benefits that we might expect. I feel that most of us have been advocating that we back off, take a long-range approach, look at this thing as a system, as an operational entity, and try to understand it.

Mr. BUSH. I believe that is all, Mr. Chairman.

Mr. ROBERTS. Do we have any figures that we can pin down on how much we are spending per fatality in this country for traffic safety?

Dr. MCFARLAND. Do you mean for research or for the overall cost?

Mr. ROBERTS. Research.

Dr. MCFARLAND. I think that would be very hard to estimate. Dr. Dunlap suggested $2 million.

Would anyone else care to make an estimate?

Mr. BAKER. There was an estimate made at Williamsburg of $5 million.

Mr. ROBERTS. What would that figure, about $2 a head? It seems to me that someone testified that we were spending about $2.50 per fatality and about 70 cents per accident in hearings last year.

Mr. JOHNSON. Yes, sir, there were some figures, but when you try to pin them down, they squirm. At Williamsburg there were several people, Dr. Goddard, and Bill Sherman, from the Automobile Manufacturers Association, and several others, who had special knowledge in particular fields. They put together an educated guess which totals about $5 million.

Mr. ROBERTS. Let me ask Colonel Stapp a question.

How much is the Air Force spending on your particular project?

That is the only one in the Air Force, I believe.

Colonel STAPP. We were given $5,000 this year and told that that was it, not to ask for any more.

Dr. MCFARLAND. In regard to our Commission on Accidental Trauma of the AFEB in the Department of Defense, the funds are contributed through the Research and Development Division, Office of the Surgeon General, Department of the Army. The fund for accident research has amounted to about $250,000 or a quarter of a million dollars per year for the past 5 years.

There are 13 commissions in this agency in the Department of Defense, and those commissions are organized on the basis of the need for the problem, and they continue as long as the need exists.

In our Commission on Accidents we have 5 major projects which have continued through a period of 5 years. We continually try to reorient the program to the problems of the military services. The three services certainly work together very effectively. A similar directive goes out for all three of the services when specific recommendations are formulated. It shows that effective collaboration can be obtained when the research programs are properly organized

and oriented. The principal investigators do not receive funds themselves, but there is a high degree of motivation because of the interest in the problems. I think one of the greatest difficulties is to develop methods that will create the desire to do the research on the part of those who might become interested. It is very difficult to purchase interest, motivation, and talent in research work. Scientists do it because they love to do it. All that research workers want is freedom to do the work in which they are interested.

I feel sure that if we could find additional funds to do this job, many scientists might become interested, and a great deal more could be discovered to help prevent highway accidents.

Mr. ROBERTS. I do not suppose there would be any way of finding out how much private industry is contributing, but I do believe that we would certainly find out how much the Government is spending in these fields. I am wondering if one of the panelists, either you, Dr. Goddard or Mr. Holmes——

Dr. MCFARLAND. Would you assign that problem to a committee that could report back?

Mr. ROBERTS. That would be a real service. We could make that a part of the record, and leave the hearings open until we get the information.

Dr. MCFARLAND. I have a list of most of the agencies doing research in this field, but I do not have their budgets.

Mr. JOHNSON. Wouldn't it be well to point out that if this figure of $5 million turns out to be approximately correct, that would be one-tenth of 1 percent of the annual economic cost of accidents?

Mr. ROBERTS. That is using the $5 million figure?

Mr. JOHNSON. Yes. We spend annually on research one-tenth of 1 percent of what we waste through the medium of accidents.

Mr. ROBERTS. Gentlemen, it is my understanding that you want to get away at 4 o'clock. I know some of you have plane reservations and other engagements.

Can you think of anything else, Doctor?

Dr. MCFARLAND. No, Mr. Chairman.

Mr. ROBERTS. Again, the Chair would like to express the thanks of the subcommittee for this fine presentation and for the time and effort and the inconvenience that some of you have suffered in coming here. I think you made a fine contribution. I know that all of us feel that you are certainly due the thanks of our group for coming here.

It has been excellently presented and well handled. I am sorry that business on the floor has prevented us from having the full attendance of the subcommittee. I am certainly sorry that we were not able to give you our full time.

Again, however, I hope we will soon have the pleasure of having you back, or meeting you on some other occasion. The statements that have been made, the formal statements, will all be incorporated in the record. We will endeavor to send each panelist the record for any corrections that you would like to make before final printing.

If there is no further business, the subcommitee will be adjourned.

(The following letter was later received for the record:)

DUNLAP & ASSOCIATES, INC.,
Stamford, Conn., April 30, 1958.

Hon. KENNETH A. ROBERTS,
Chairman, Traffic Safety Subcommittee,
Old House Office Building, Washington, D. C.

DEAR MR. ROBERTS: The hearings before the committee were interesting and informative, despite the variation in the content of the presentations. For my part, I was pleased to participate and trust my remarks may have been of some value to you and your associates. I want to thank you for inviting me to the Tuesday evening get-acquainted session.

I should like to expand on my unfortunately blunt reaction to the question on funds. The responses appeared to be piecemeal and biased toward specific elements and groups, whereas I believe you require for your purposes a broad, long-range, systematic approach to the support of accident research.

A comprehensive answer would require entirely too much detail for a casual letter, so I shall confine myself to certain broad aspects of the problem. The first step in developing an answer would require the development of criteria against which to measure and evaluate the various requirements. A few such are suggested below.

1. What is the nature of the research we wish to support?
   (*a*) Short term.
   (*b*) Long range.
   (*c*) Field studies.
   (*d*) Laboratory studies.
   (*e*) Applied studies.
   (*f*) Theoretical studies.
   (*g*) Et al.
2. Whose needs should be served?
   (*a*) The armed services.
   (*b*) Governmental agencies.
   (*c*) State agencies.
   (*d*) Municipalities.
   (*e*) Industry.
   (*f*) Insurance companies, etc.
3. Who should carry out the research studies?
   (*a*) Government agencies.
   (*b*) Universites.
   (*c*) Foundations.
   (*d*) Private research groups.
4. Who should supply the funds?
   (*a*) A direct grant from Congress.
   (*b*) Allocations from various Government agencies, i. e., Army, Navy, etc.
   (*c*) Grants from business and industrial groups, i. e., automotive manufacturers, truckers' associations, oil companies, insurance companies, etc.
   (*d*) Multiagency support.
5. Who should coordinate and administer the various research projects?
   (*a*) New Government agency.
   (*b*) A subgroup under an established agency, i. e., NRC.
   (*c*) Management group under contract who could be held accountable financially and professionally. Example: Ramo-Wooldridge's management contract for ICBM's with the Air Force.

Guessing something of the busy and hectic life you and the members of the committee live, Congress should support you with technical assistance to analyze the committee's records and to assist in preparing a feasibility report as a basis for the committee's next steps. Such technical assistance to include some knowledge of the accident problem, the economics involved, and experience in developing long-range programs.

I am in Washington quite frequently and if I can be of further assistance to you and the committee, I will be pleased to help.

Cordially,

JACK W. DUNLAP, Ph. D., *President.*

(Whereupon, at 4:10 p. m., the hearing was concluded.)

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